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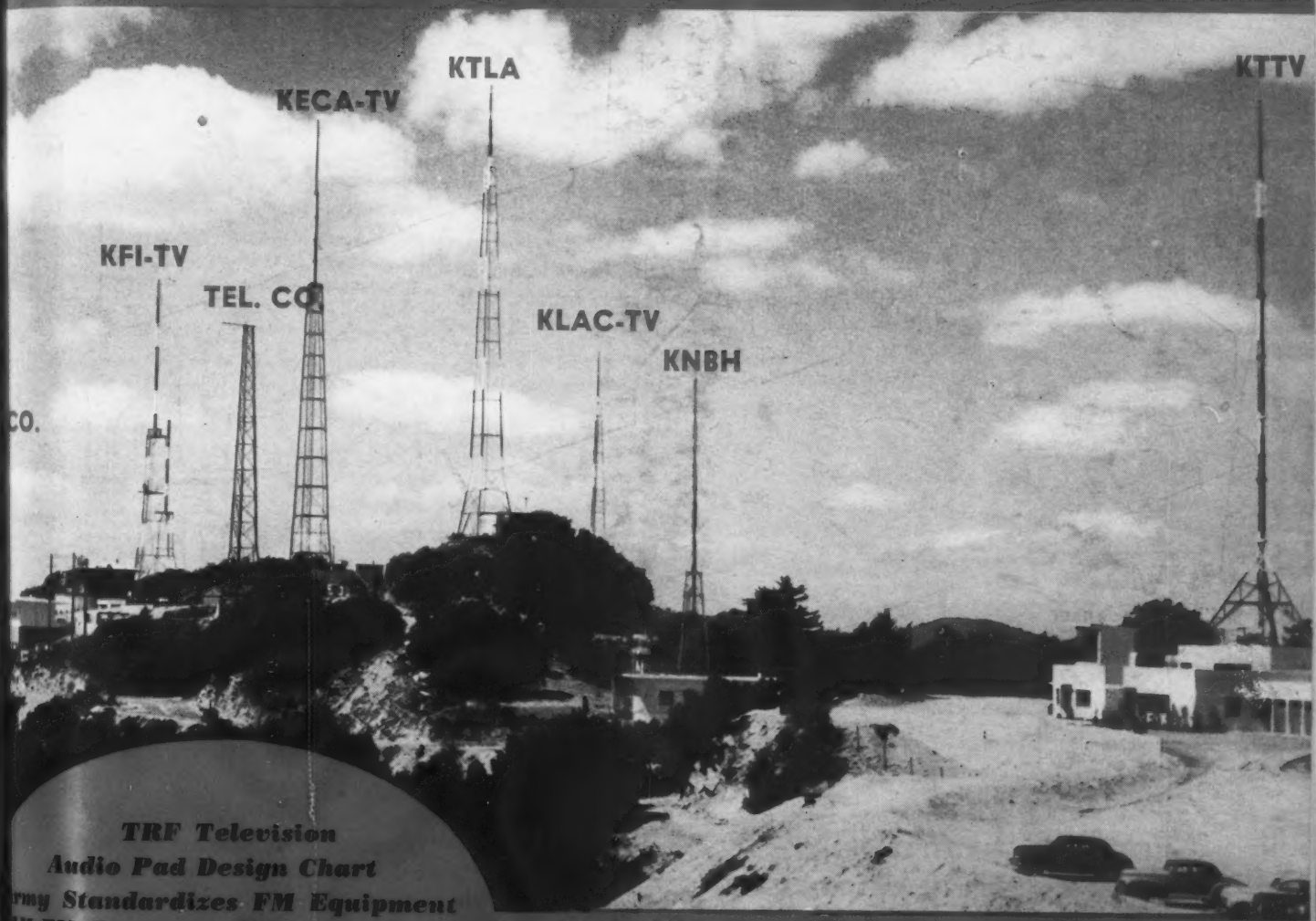
IN TWO PARTS • PART ONE



Above — Broadcast antennas atop Mount Wilson
Below — Night view of Los Angeles area served, from the antenna site

TRF Television
Audio Pad Design Chart
rmy Standardizes FM Equipment
AM-FM Coverage Chart — See Part Two

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August • 1949

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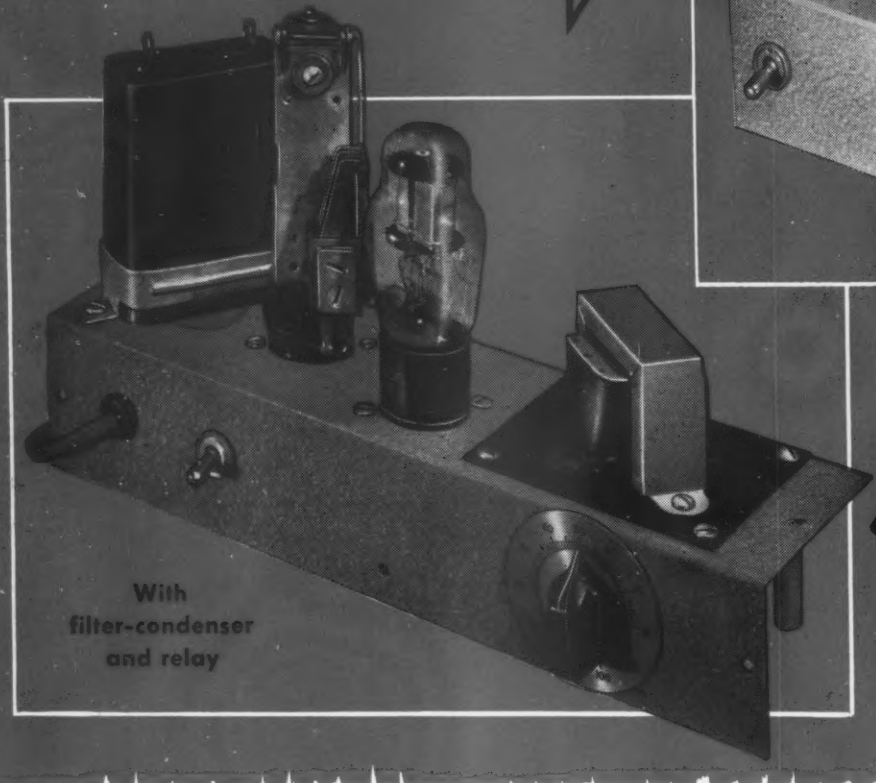

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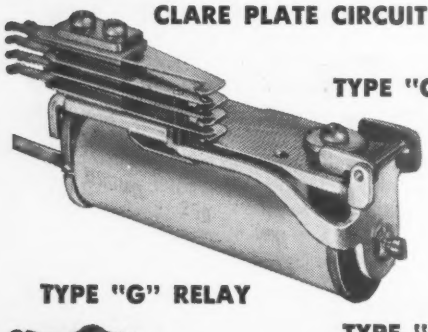

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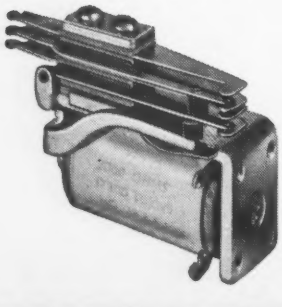
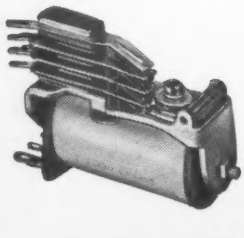
TYPE "G" RELAY



TYPE "J" RELAY



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TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

AUGUST, 1949

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COVER: TV & FM TRANSMITTER TOWERS ATOP LOS ANGELES' "MT. VIDEO" and the night-time view from this 6000-ft. elevation, covering Altadena, Pasadena, Glendale, Santa Anna, Pomona, Los Angeles, Vernon, etc., with a 2,500,000 population. For these pictures we are indebted to Dr. Lee deForest, radio pioneer and inventor of the audion, to whom they were presented by Alfred Childs, owner of Mt. Wilson. "All but two of the transmitters are fed by short cable from the telephone station which picks up the several beams from Hollywood," reports Dr. deForest, adding, "KTLA and KTTV beam their own".

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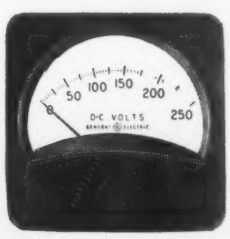
This brand-new line of 2½-inch thin panel instruments has streamlined features which will give your panels a "new look." Arc lines have been eliminated,



GENERAL ELECTRIC

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

WATCH THAT INVENTORY!—We agree with TV industry prophets that the U. S. market will absorb two to 2½ million television receivers during '49. (This despite the present FCC "freeze", which is holding back retail sales, and even the early lifting of which cannot be effective at the consumer level before next year!) But our editors have also been quietly compiling the *individual* production schedules reported *planned* by all principal TV makers for '49, and we find these add up to 3 to 3½ million sets for the year, with the *last half of '49 alone* booked to exceed 2½ million sets! Such racing toward overproduction and disaster in the next four or five months calls for some careful stabilizing of production right now!—coupled with putting new pressure on aggressive selling, all along the line! There can be disaster for all, if the TV market is glutted by December. Careful!

WHAT PRICE SATISFACTION?—What is satisfaction worth! The automobile has become an American standard for living. In addition to its utility, "a car" gives its owner prestige—by its ownership he feels he is on a par with his neighbors. No small part of the value he receives is in the satisfaction of ownership, but he pays a lot for this. The automobile industry could put out a car at half the cost, and in some cases has done it, but according to automotive leaders' own statements such a utility car would not sell sufficiently to warrant the effort. Car buyers want good transportation but they also want style, comfort and convenience besides. The average auto gives its owner perhaps a little over 1,000 hours of use before he wants a new one. So a thousand dollars for "extras" amounts to around a dollar an hour!

TV's "DO IT CHEAP!"—How different television-receiver manufacture has been! Too many TV makers have jumped into the competitive spirit with a self-imposed slogan of "do it cheap." Here is a product costing only a few hundred dollars that gives continuous pleasure for many thousands of hours, at an upkeep and operational cost only a fraction of that required by a car.

Yet a furor is still going on over efforts to save another $5. on manufacturing costs, in order to give the customers a still cheaper price. To hell with the problems of eye-strain, jiggled images, cramped viewing conditions, and distorted, poor contrasty pictures that are introduced by such tactics. Too many seem to want to sell this TV art by promoting cheapness.

NICKELODEON PARALLEL — The nickelodeon started the movie industry at a five-cent level. But as motion pictures grew up, the public showed its aversion to dim flickering noisy shows. The level of satisfaction at a reasonable cost factor progressively reached higher levels, as it did with the automobile. Here again the cost per hour of enjoyment (on a per individual basis, compared with that spread over a car full of people) runs to even higher levels.

PEEP-HOLE STANDARDS—Thousands of viewers are continuing to get the wrong ideas of television quality by seeing only price-developed equipment in miniature sizes. Families in the prosperous two and three-car class too often purchase $199.99 television receivers and naturally do not get very enthusiastic about TV. A good big-picture television set of the direct view or projection type will give many hours of pleasure and satisfaction to the home group. And the extra cost of such stable satisfactory clear "big picture" television will be no more than the price of a few of the extra conveniences that are found on any modern car, and that are accepted without argument.

BOOM MIKE; MIKE NETWORKS—It was not so long ago that the standard way of lighting a room was to drop a single naked electric bulb on a cord near where the user might work. It took many years to show that a room completely lighted from several sources clipped the anchor chains and permitted occupants to move around. Strangely the same archaic rules have been in use by the broadcasters as regards microphone placement. One, two and sometimes as many as five artists have bobbed in and out from a single microphone on a stand—and, what makes the story even more unusual jumped over the cables all the while!

Television technics have started the spiral of progress by introducing the boom-held microphone that can be kept out of the way and allowed some movements by the cast. Such boom mikes are now proposed for sound broadcast studios, as well. The WOR engineers in New York go even farther in their plans,—which contemplate overhead microphone networks which will give complete freedom to artists and apply Bell Lab. placement.*

* See Tele-Tech, July '47, page 44

Army Standardizes

New series of FM equipment features ease of maintenance, Transceivers form the foundation of each installation and

By CHARLES DEVORE, Signal Corps, US Army, Fort Monmouth, N. J.

ANOTHER phase in the overall standardization program[1] of the Signal Corps and of the Military establishment has been completed by the development of a standardized series of FM radio sets. Intended for field, vehicular, and manpack use, and for general short and medium-range communication applications, the new sets are 35% lighter and have a power drain 59% lower than existing types.

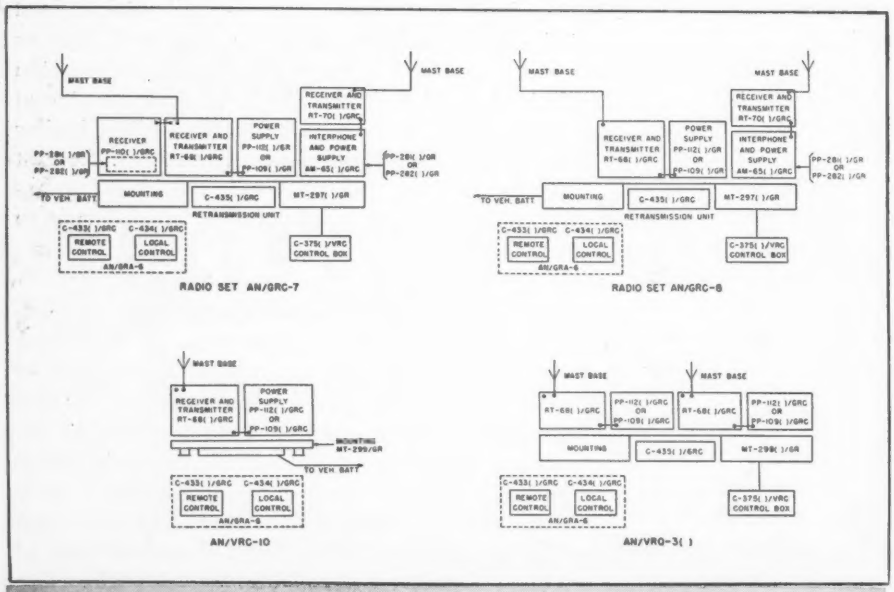
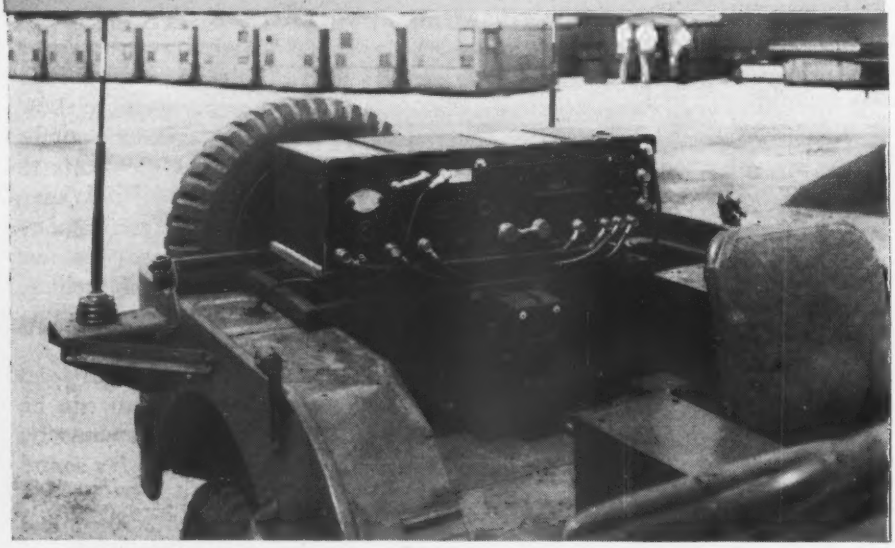


Fig. 1. Standardized interchangeable components of FM assemblies for use by the infantry

Fig. 2. Radio set AN/GRC-7 installed in a jeep. Units from left to right include the following: auxiliary receiver, transceiver ("A"), vibrator power supply, transceiver ("B")



One or another of these radio sets will replace, either wholly or in part, a majority of the types of FM sets now in military use in the 20-48 MC range, as well as certain AM sets. Automatic retransmission (or radio relay), immersion proofing, continuous tuning, and crystal savings are design features of the new series. They also provide more than 100 new radio channels for the intended military communication applications.

The sets forming the new series are comprised of various assemblies of a group of major standardized components featuring maximum interchangeability. Since they are intended primarily for vehicular temperature range from —40 to and other armored, artillery or infantry vehicles), smallness and lightness were requisite design considerations. No unit weighs more than 37 pounds and the maximum dimensions are 9 x 11-3/16 x 12-13/16 in., the dimensions of the so-called "A" set.

Immersion Proof Components

To meet another highly important military requirement, each of the major components has been made immersion proof — protecting the equipment from damage by heavy rain or short periods of immersion in water. The sets have also been designed for operation under various climatic conditions, being suitable for operation over an ambient temperature range from —40 to 65° C. The chassis structure of each of the major units is supported by a cast front panel. A water-tight cover enclosing the unit is held tight against a rubber gasket on the front panel with special easily opened fastener. Glands on the shafts of all controls, combined with immersion-proof jacks and connectors make the front panel a watertight assembly. As an extra precaution in the event

FM Equipment

interchangeability and proofing against immersion in water. provide modulated powers of 500 milliwatts to 20 watts.

the operator does not always properly clamp the cover in place, the radio components and wiring are treated for operation under high humidity conditions.

Basically, the new series comprises an "A" set, with an output of 15-20 watts, plus a low-powered "B" set, with an output of ½ watt. Transceivers are the major components of both the "A" and the "B" sets. The "A" sets, Receiver-Transmitters RT-66( )/GRC, RT-67( )/GRC, and RT-68( )/GRC, are FM transceivers identical in size and shape and similar electrically, except for the components that determine their frequency coverage. These transceivers have three frequency ranges, as follows:

Type Set	Frequency Range (MC)	Channels Available
RT-66( )/GRC	20-27.9	80
RT-67( )/GRC	27-38.9	120
RT-68( )/GRC	38-54.9	170

The desired frequency is selected rapidly by two tuning controls, one with detents for every megacycle (ten channels), and the other with detents for every tenth of a megacycle. The first, or RF control, controls a crystal oscillator-harmonic generator circuit, while the second is associated with a variable low-frequency oscillator and IF amplifier. The frequency of the crystal oscillator remains fixed for each group of ten adjacent channels; only one crystal is required for each megacycle of range. Frequency stability of the combination of crystal oscillator harmonic generator and variable oscillator circuits is approximately 0.02%.

The detent mechanism of the IF control may be released to permit continuous tuning over the range of 100 KC (one channel), permitting reception of signals from transmitters not crystal-controlled.

After the installation adjustments have been made, all circuits, including those for the antenna, may be tuned by the two front panel controls only. The "A" set circuits may be switched from "receive" to "transmit" by simply depressing the microphone "press to talk" button. Wherever possible, the receiver circuits are utilized during transmission. Under average conditions, the communication range of the "A" sets is 10 miles in motion, 15 miles when stationary, and 25 miles with elevated type antennas. The equipment is intended for voice operation only. Squelch circuits in the transceivers reduce the noise when no signals are being received and also provide DC for the operation of an external relay, when the "A" set is used for radio relay operation.

For vehicular installations of the "A" sets, operating voltages are supplied by vibrator power supplies PP-109( )/GR or PP-112( )/GR, which differ only with respect to the primary supply voltage, the first unit being provided for a 12-V source and the second for a 24-V source. Future Army vehicles will have 24-V electrical systems, so that the PP-109( )/GR is intended only for interim use. A three-position switch on the power unit en-

(*Please turn to next page*)

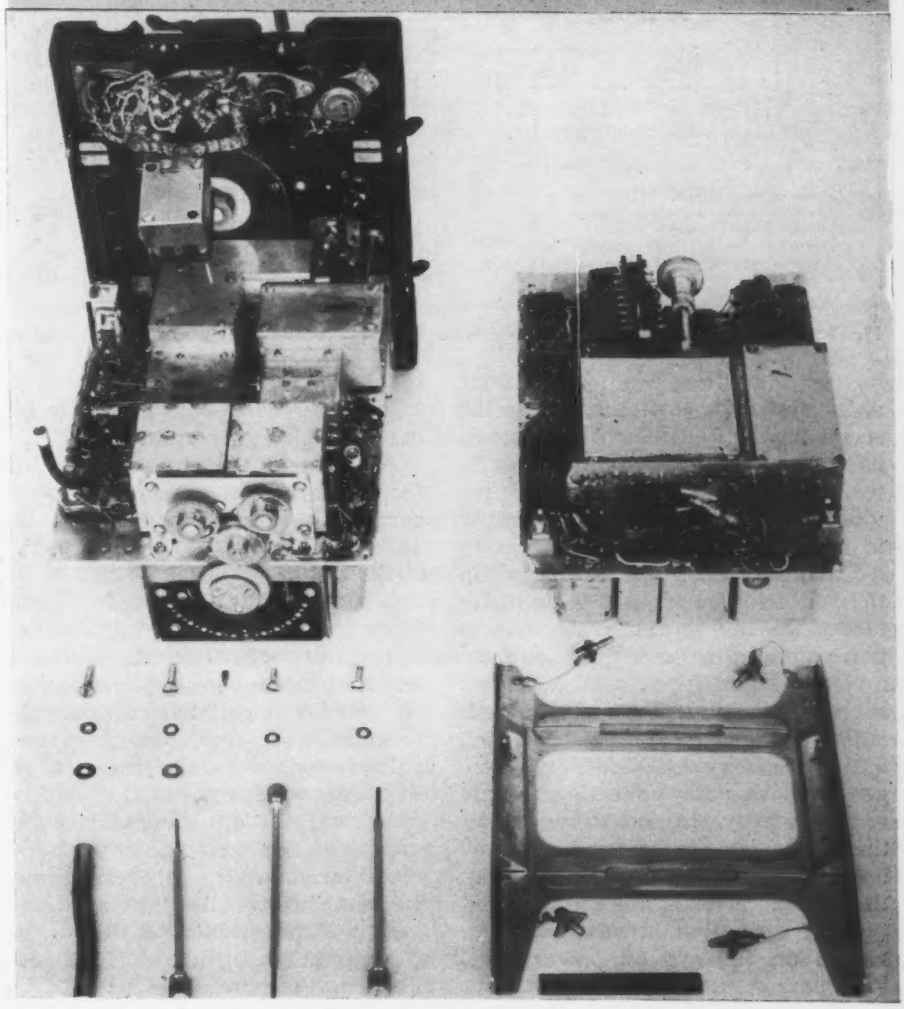


Fig. 3. Ease of maintenance is evident in this stripped view of an "A" type transceiver

ARMY STANDARDIZES FM (Continued)

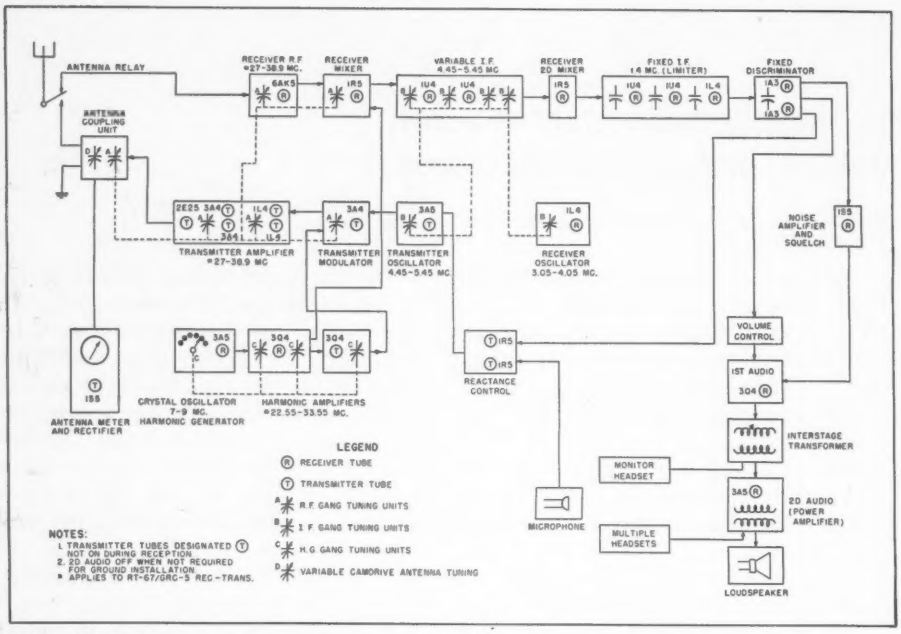


Fig. 4. Block diagram of "A" type transceiver. Many units are common to both operations

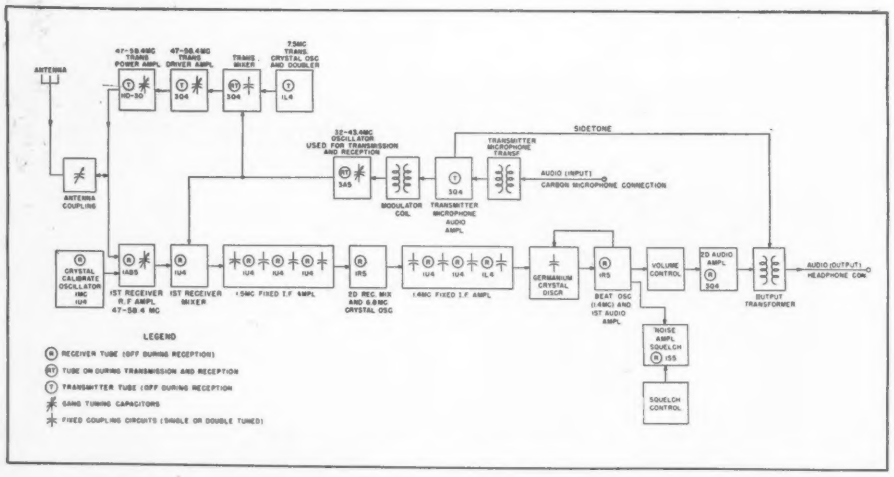


Fig. 5. Block diagram of "B" type transceiver. Can be used as pack, mobile or ground set

ables the operator to turn on the receiver or to turn on simultaneously the receiver and the transmitter. A high-low power switch provides for selection of voltage supply to the transmitter.

Filament tubes are employed in the "A" set where possible, in order to reduce the power drain and to permit operation as a field set from a conventional type hand generator such as G-8( )/GRC which will supply voltages of 450, 250, 150, 90, 6.3, and −30 volts, DC. In an emergency, power for operation of the receiver may also be drawn from the generator. A front panel connector provides for connection to the hand generator; the desired type of operation is selected by a switch on the ground power unit. Full power output of the "A" set transmitter can be obtained by using the hand generator.

A series of 14-tube receivers referred to as "auxiliary receivers" cover the same frequency as the "A" sets: R-108( )/GRC (20-27.9 MC); R-109( )/GRC 27-38.9 MC); and R-110( )/GRC 38-54.9 MC. They are intended for use in those applications where no transmitter is required, or in conjunction with an "A" set for guard channel operation or as part of a radio relay system.

These receivers are identical in all respects except for the components which determine their frequency range, and their performance characteristics are essentially the same as for the "A" set. Frequency is determined by the setting of a single tuning knob. Three preset frequencies may be selected by the setting of three adjustable detents. Vernier adjustment of the detent location is provided by knobs on the front panel. A crystal calibrate oscillator may be energized by means of a "tune-operate" switch on the front panel so that the operator may check his dial calibration by turning the dial to certain marked calibration points.

Squelch circuits in the auxiliary receivers serve the same purpose as those in the "A" set. A coaxial antenna connection on the "A" sets permits parallel connection of the auxiliary receiver. A relay in the "A" set removes the antenna connection from the auxiliary receiver and disables the auxiliary receiver audio circuit during periods of transmission by the "A" set.

Self-contained vibrator power supplies (PP-281( )/GRC and PP-282( )/GRC), operating from 12- or 24-V vehicular batteries, respectively, furnish plate voltage supplies for the auxiliary receivers.

Low Power "B" Set

In addition to the "A" sets, a smaller, low - power transceiver known as the "B" set, was designed particularly for short-range communication between a vehicle and supporting ground troops equipped with pack sets. Designated as Receiver-Transmitter RT-70( )/GRC, it provides 115 voice channels over the range of 47 to 58.4 MC, including part of the frequency band normally used for pack sets. The "B" set may be used as a pack set in some applications, although its size and electrical characteristics were dictated primarily by the requirements of a vehicular installation. When used with a battery pack, it may be removed from the vehicle and carried to an advance location, there being used for communication with a "B" set in the vehicle.

As in the case of the "auxiliary" receivers, setting a single tuning knob determines the frequency of the "B" set. Two frequencies may be selected by the setting of adjustable detents, which are readily accessible on the front panel. These detents may be set to any desired frequency by tuning the receiver to a detent frequency, releasing the detent lever tuning to the desired frequency and locking the detent lever. In addition to the main tuning dial, the tuning knob is provided with dial markings so that vernier settings may be observed by reading the setting of the scale on the knob.

A crystal calibrate oscillator on the "B" set allows the operator to check the dial calibration and correct the tuning of the "B" set at one-megacycle intervals throughout the tuning range.

The average RF power output of the "B" set transmitter is approximately 500 milliwatts—sufficient for reliable communication between vehicles up to distances of about one mile, or up to five miles under favorable conditions. The performance of the receiver circuits with regard to sensitivity and selectivity is comparable with that of the "A" set and the "auxiliary" receiver. At any tuning frequency, the "B" set circuits may be switched from reception to transmission by pressing the microphone "press-to-talk" button. A squelch circuit is provided similar to that used in the "A" set and auxiliary receiver.

Performance Characteristics of "A" Set Transceivers

Receiver circuit

Sensitivity:
20 db S/N at ½ microvolt (all ranges)
(Deviation ± 15 kc 1000 cps)
First IF:
4.45 to 5.45 MC (variable)
Second IF:
1.4 MC
Second mixer oscillator frequency range:
3.05 to 4.05 MC (variable)
Bandwidth (Average "A" set):
80 KC (6 db down)
140 KC (30 db down)
200 KC (60 db down)
Audio Power output:
Loudspeaker jack:—1 watt
Phones jack:—50 mw (power audio operative)
100 mw (power audio inoperative)
Audio output impedance:
600 ohms
Noise suppression:
Squelch
(a) Adjustable from front panel
(b) Approximate sensitivity, ½ microvolt

Transmitter Circuit

Nominal power output:
(high power) 10 to 16 watts
(low power) 1 to 2 watts
Maximum frequency deviation:
approximately 50 KC (voice)
Transmitter mixer oscillator frequency range:
4.45 to 5.45 MC
Transmission frequency:
same as receiver

When the "B" set is used in a vehicle, it is designed to mount on the interphone Amplifier Unit AM-65( )/GRC, which provides power supply circuits for the "B" set, and also serves as junction box for "B" set systems connections.

This amplifier unit is also the basic unit in an intercommunication system, which consists, in addition, of an "A" set, a "B" set, and two or more Control Boxes C-375( )/VRC. Each control box serves as a jackbox for microphones and headsets for two operators with separate volume control for each user.

Unlike conventional interphone systems, the one used in the standardized series of the FM sets provides for electronic mixing of the radio set output with the output of the interphone system so that the output of the interphone system may be heard at all times by all persons in the vehicle. A choice of three audio circuits may be selected by a switch on the face of the control box. One circuit combines the output of two radio sets ("A" set and "B" set) with the output of the interphone amplifier so that an operator may monitor all three outputs at the same time. A second audio channel combines the output of one of the transceivers with the output of the interphone system at reduced level. A third channel combines the output of the other transceiver with the output of the interphone system in the background. A spring-loaded switch on top of the control box may be pushed to one side to allow an operator to transmit over either radio set.

This electronic mixing is accomplished in the interphone amplifier by providing two amplifier tubes for the amplification of the microphone output. The output of each of these tubes is combined with the output of one of the two radio sets to provide the two reduced level channels referred to. The output of these two tubes is combined in a mixer-amplifier circuit to provide the third, or high-level channel. A separate amplifier is provided to amplify the output of the "B" set prior to mixing with the output of the one of the interphone amplifier tubes.

A volume control and power switch is mounted on the front panel of the interphone amplifier. This switch will (1) turn on the "B" set only, (2) turn on both the "B" set and the interphone, or (3) turn all off.

Mounting Bases

Mounting bases have been designed to accommodate different numbers of the basic components. These are similar except for dimensional variations to correspond to the width of the assembled components. The bases present essentially a flat surface, which can be used as a shell when the sets are not mounted. Levers along the front edge activate latching springs which lock the feet of the components in the channeled top surface. Standard shock mounts are used. Under each base is a terminal box for connecting systems and power wiring.

Radio Relay operation of two transceivers is provided through the use of a Control Unit C-435( )/GRC, which permits automatic or manual retransmission. Since the activating units are transceivers, only simplex operation is possible, that is, only one message in only one direction can be handled at any one time. The control unit mounts under the mounting bases of the assembly.

The retransmission device operates in this way: If power is on, and the selector switch is set on "automatic", the receivers of the two transceivers have closed squelch circuits, each awaiting reception of a carrier. When a carrier is received. the squelch circuit closes the relay in the control box. This relay operates the transmitter relay of the second transceiver. The received signal modulates the output of the second transmitter, thus retransmitting the message. When the carrier goes off, the squelch circuit closes, releasing the control relay and returning the circuit to receive. The equipment is then ready for reception of a carrier signal on either receiver. Indicator lights show which set is receiving the message, and it is possible to monitor the signal. Transmitting and receiving levels may be independently adjusted by volume controls on the unit. Retransmission is possible between two transceivers provided proper choice of frequencies is made in accordance with charts furnished with the equipment.

Other control functions are provided by the Control Group AN/

(*Continued on page* 59)

New TV Studio Relay

Design provides economical means of switching for enlargement, and finds important applications in larger

By W. E. TUCKER & C. R. MONRO, Television Terminal Equipment Group, RCA Victor Division, Camden, N. J.

WHETHER a television installation is small or large, it will be found necessary to switch video signals in some manner. Until recently, the majority of systems have employed mechanically interlocked push switches; located directly in the video lines, which have provided for the connection of a maximum of six video signal sources to a maxium of three lines. For these conditions, the control panel becomes too large to be located conveniently for the operator, due mainly to the various video coaxial cables. Smaller panels, located at the operator's position, have been made which will switch any one of six video signals to two lines.

A television station may be called upon from time to time to handle many variations of program material in its operating schedule. Maximum flexibility must therefore be held in the performance and utilization of all equipment. One means for accomplishing this is to provide video switching in one or more studios, wherein the program is assembled from all necessary sources, and then passed on to the second control point for final distribution to transmitter and network.

In a relatively small station, and

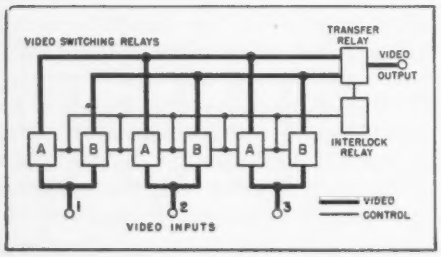


Fig. 1: Block diagram showing fundamental switching scheme of the RCA remote control switching system. Relays A and B are electrically operated through push-buttons

especially in a large plant, where studios may be located some distance from each other, many video lines must be laid to tie studios together and provide the spare lines for possible program combinations and new facilities.

The question of future expansion is an important consideration. Being in a rapidly growing industry, even the smallest station must consider the cost of re-arranging present facilities at a later date, or installing equipment now that may be later expanded in its usefulness at minimum additional expense.

In a television system the video signals originating in field cameras, studio cameras, or film cameras are fed through coaxial lines to associ-

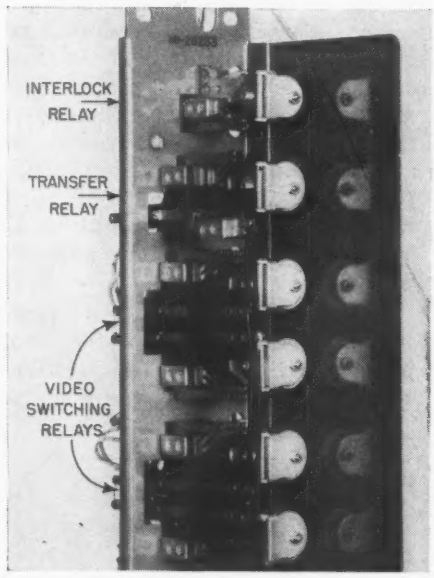


Fig. 2: Section view of the basic relay panel illustrating the interlock, transfer and video switching relays employed

ated rack-mounted equipment. If the video switches themselves can be located directly in the video lines, with the control of these switches where desired, then the video lines may be completely centralized and we have reached a practical solution of the problem. Video relays are the answer.

There are other functions which must be performed, such as providing for tally light operation, line termination, isolation of video inputs

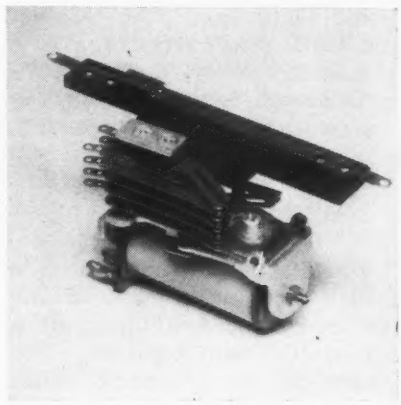


Fig. 3: Close-up of a video switching relay

and outputs, and sync interlocking. The mechanical arrangement of the components must be such that the basic equipment will provide economical switching for the small station while, by additions, it will apply to the larger installations.

The circuits must have a minimum of capacity across the video contacts as well as the smallest possible capacity to ground in order to reduce high frequency and line losses and cross talk. Other requirements include the use of simple non-locking push keys to operate the relay coils, relays to be operated in a lock-up type circuit — interconnected to drop out any operated relay when another is operated. The switch-over time should be as short as possible, and switch-over should be arranged so that either gap or overlap can be obtained.

It has been found that, for minimum picture disturbance during switch-over, a slight overlap or make-before-break sequence is desirable. A zero transfer interval would be ideal, but is impractical. Overlap is chosen to avoid occurrence of black areas when switching between two similarly lighted scenes. The circuits can be arranged so that double termination is picked up during the transfer to prevent undesirable flashes. This arrange-

Switching System

smaller stations, is adaptable to modifications for stations where it is impossible to use manual switching

ment is commonly used for camera switching. For preview monitors, however, the switching must cross over active lines without introducing any disturbances. For this application, a gap (break-before-make) sequence is desirable. The same condition exists in Master Control switching. Although, in this case, switching is most often done only between programs, the transfer interval, as in camera switching, again appears on the outgoing video signal and hence must be as short as possible.

In the course of the development of the relay switching system, several fundamental circuits were tested for conformance to the specifications set up. The simplest circuit used a mechanically interlocked push-button assembly to operate the video relays. This, however, becomes the worst case for switch-over timing, since both the push-button assembly and the relays themselves will contribute variations in the timing. The next general circuit was one in which the latching action was electrical. Briefly, on operation each relay switches itself to a "hold" bus which is in turn controlled by a separate control relay group. In this way, a gap sequence may be set up in which a push button initiates a step sequence through the control relays to release the hold on any relays already operated, restore the hold bus, and then operate the desired new video relay. Here again the switch-over time was governed by the operate and release times of the relays involved. Either timing adjustments must be provided for each relay or all of the relays must be adjusted for very critical uniformity. Also, this circuit was not easily adaptable for overlap switching, although a system using double coil relays, carefully adjusted for timing and uniformity, has been made to work quite satisfactorily. It must be remembered that we are aiming for a switch-over time of less than 10 milliseconds.

The circuit finally chosen met all of the requirements for timing and yet the switching interval was in-

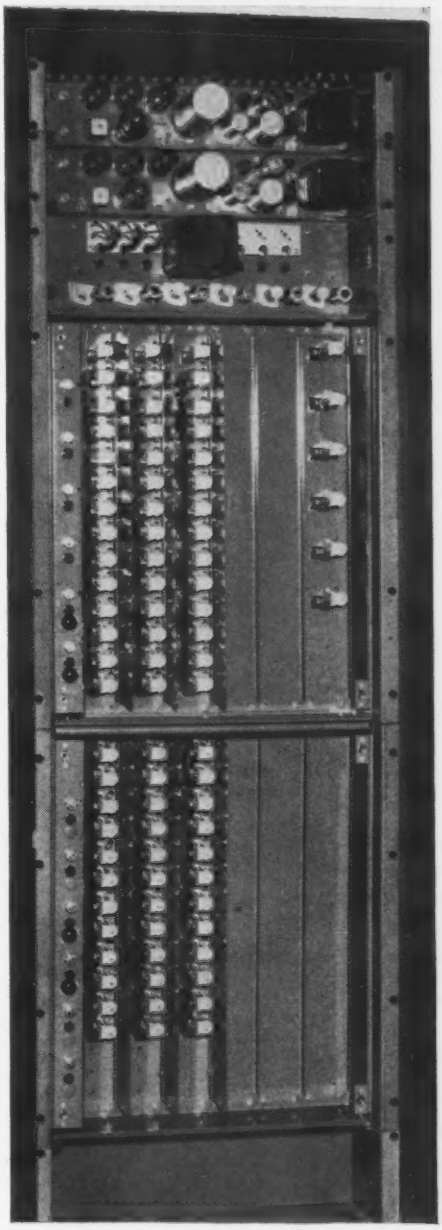


Fig. 4: View of remote switching equipment (TS-20A) mounted in a standard TV rack

fluenced only by one transfer relay instead of by all the relays involved. A short description of the circuit and physical arrangements follows: (see video diagram, Fig. 1 and relay arrangement, Fig. 2).

Each incoming video channel is connected to make contacts on a pair of switching relays. The other side of these contacts connects to two video bus wires which in turn run to a transfer relay. When a channel selecting push button is operated, one of the switching relays, (let us call it "A"), will close, connecting the incoming line to one of the transfer bus wires. Next, other contacts on this switching relay operate the transfer relay to connect the outgoing line to the video bus wire and so to the incoming circuit. When some other push button is pressed, a circuit from separate contacts on the transfer relay will tell this video switching pair that the "A" bus is in use and so the "B" switching relay will operate. The video contacts on the "B" relay close to connect the new incoming video line to the "B" video transfer bus wire. Other contacts on the "B" relay close to operate an interlock relay which in turn releases the transfer relay. The outgoing line is thus transferred from the original input to the new one. As the transfer relay releases, the same "busy" circuit releases its hold on the old circuit's "A" relay. This process repeats as subsequent push buttons are operated. Actual transfer, as seen by the output circuit, is therefore accomplished in the time it takes for contact travel on the transfer relay. Also, an arrangement of contacts is provided such that either gap (break-before-make) or overlap (make-before-break) switching may be chosen by making appropriate connections to the video transfer bus wires. All of the switching relays are now freed from critical timing problems and short time—½ to 1½ milliseconds—transfer is easily and consistently accomplished. Two separate sets of contacts, parallel connected on each video switching pair, are provided for the signal or control circuits of camera tally lamps and sync interlock. Since the relay circuit is completely self latching, any type of push button or key may be used, provided only that, if mechanically interlocked, their sequence is break-before-make. Also, some other relay switching circuit may serve as the

(*Please turn to next page*)

TV STUDIO RELAY (Continued)

control as might be done in audio-video switching or in a preset system. For all of these variations, the transfer timing is determined entirely by the transfer relay.

Mechanically, the video switching relays (Fig. 3) are of the small telephone type. The video contacts are arranged on a bakelite insulator, spaced well away from the relay frame. The input side of the video contacts extends down through the chassis and the output side stands above the relay frame. In this way, both stray-to-ground and lead-through capacities are very low. The relays are mounted on long narrow panels which in turn mount in a chassis for rack mounting. One type of panel termed "basic" provides for 6 input circuits and one output through the transfer relay. A second type of panel termed "auxiliary" provides for 6 additional inputs, without a transfer relay, since it is to be used only to extend the basic panel. The chassis for basic panels includes six input video line terminations and a cathode follower isolation amplifier for each of the six panels which may be mounted in it. The basic chassis is normally supplied with two panels in place, the additional panels being added at the customer's option. Another relay is provided in each output to short circuit the video when the release button is pushed to clear all of the video switching relays. Its circuit is arranged to hold it operated as long as any switching relays are operated and so its action does not appear in normal transfer switching. The chassis for the auxiliary panels includes only the input terminations, since the auxiliary relays work into the same transfer relays and output circuits appearing in the basic chassis.

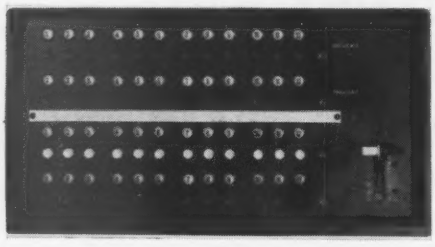


Fig. 5: Closeup of push-button switching panel which may be mounted in the program director's console illustrated in Fig. 7

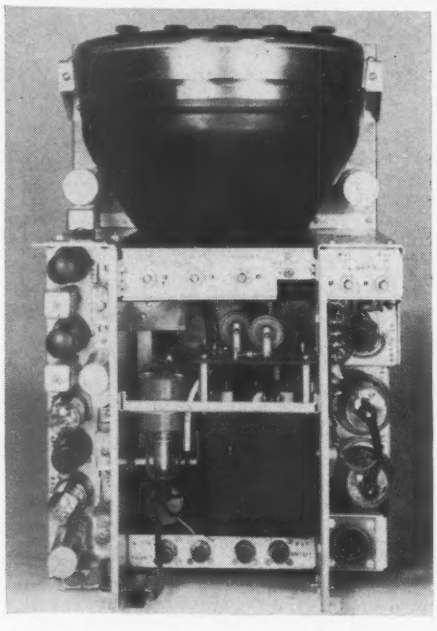


Fig. 6: Program monitor chassis showing components and locations for adjustment

Fig. 7: (Below) Program director's console contains program monitors and mounts relay switching panel for studio control system

In order to employ relay switching, it must form a part of a coordinated system. The RCA Type TS-20A relay switching equipment covers a group of related units which may be used in various combinations to cover widely different conditions. (Fig. 4 shows mounted equipment.)

The TS-20A equipment consists of several types of units in each of the following categories:

1. The video relay switching chassis and the panels which are used to extend the functions of the basic units. 2. The push-button panels, for operating the video relays, which are available for several switching schemes and mounting arrangements. 3. The program or master monitors, for use in conjunction with the push-button panels. 4. The various consoles for mounting the push-button panels and monitors. 5. Standard components.

The fundamental video relay switching equipment consists of the basic chassis which provides the relays and circuits for connecting six inputs to two outputs. If more outputs are required, basic relay panels can be added, one for each output. If additional inputs are required, six more can be accommodated by using the auxiliary relay chassis with the appropriate number of auxiliary relay panels. Since either gap or overlap switching is available, the switching system may be used for studio, monitor, or master control room switching.

A tally light relay panel is also available for mounting in either the basic or auxiliary chassis. It is used to extend the number of different tally and sync interlock circuits normally handled by the video switching relay units.

Panels using non-locking push buttons (Fig. 5) are designed for mounting in a program director's console. Up to twelve inputs and four outputs are available, with provisions for normal fading between two of the outputs.

Panels using locking type push buttons are designed for mounting in a console section. Up to six inputs and two outputs are available, either with or without manual fading provisions, between the outputs.

Tally lights, for each push button, are furnished as a part of each switching panel.

Two types of monitors are available. The program monitor (Fig. 6) is designed particularly for mounting in the program director's console. The master monitor is the familiar combination of kinescope and

oscilloscope which may be mounted in a console section with video switching facilities.

To facilitate the smooth handling of studio productions, a program director's console (Fig. 7) is available. This console provides space for the video switching panel, intercom switching panels, and microphones, in a convenient desk top arrangement at which both the program director and technical director may sit. Monitors, mounted below and behind the desk top, are viewed by means of a mirror for optimum viewing distance and an unobstructed view into the studio.

A console section is available to harmonize with the standard RCA camera controls for those applications in which the switching facilities, monitors, and camera controls are to be located as a unit. The appropriate push-button panels for video switching mount in this console section.

In order to complete the system, certain standard video distribution and mixing amplifiers and power supplies are required. The number and use of these units will vary in accordance with the individual station requirements.

New Television Antenna for WCBS-TV

Unusual mechanical requirements necessitate a special design in erection of high power radiating system at New York City

THE new antenna for WCBS-TV designed by Andrew Alford the noted consultant is well on the way to completion. Because the slender spire of the Chrysler Building would not support one of the more usual types of antenna such as the popular super-turnstile, it was necessary to design an antenna which could be installed around the tower at a lower level and still provide a circular field pattern in accordance with FCC requirements, and the Standards of Good Engineering Practice.

The new antenna consists of sixteen dipole elements arranged in four stacks of four, one on each side of the tower. The sound and picture signals are diplexed following the usual practice in TV transmitters. When the installation is completed the ERP will be 13.7 KW with an antenna height of 910 ft. above average terrain. This will correspond to approximately 50 KW with 500 ft antenna height, which is the maximum allowable under the present FCC rules. Each element is seven feet long, seven inches in diameter, and weighs 375 pounds.

Since the whole antenna is somewhat different from the usual broadcast television antenna a brief description of one of the elements is given. As the drawing shows, each element is in three parts, and is of the type sometimes known as a Sleeve Dipole. The two end pieces are about half the length of the center section and insulated from it by Teflon spacers. (These show clearly in the photograph). These end pieces are held in place by a stainless steel rod of about ⅝-in. diameter which extends from one to the other through the center section.

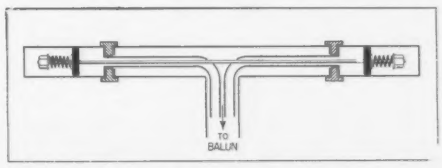


Fig. 1: Construction details of one dipole unit. Current distribution is approximately the same as for a standard dipole antenna

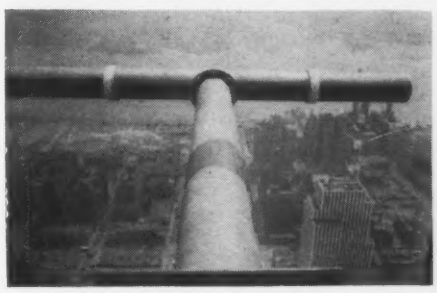


Fig. 2: Completed antenna unit in position on Chrysler Tower. Note Teflon insulators

Fig. 3: Impedance and S.W.R. measurements in progress using the new General Radio type 1601-A VHF impedance bridge. Bridge operates over a range of 20 to 140 MC

Each end piece has an anchor plate through which the rod passes. Spring tension obtained by means of coil springs placed between the anchor plates and the retaining nuts on the ends of the rod holds the end pieces firmly in place. The feed to the ends is through two inch copper tubing which runs concentrically with the stainless steel rod. A Balun for matching the antenna to the line impedance of 51 ohms is contained in the seven foot mounting section. All the exposed parts are made of stainless steel #304 alloy, while the internal parts are made of copper and brass. When the antenna is completed it is expected that the standing wave ratio for the whole installation will not exceed 1.15 over the 6 MC channel width. Among the reasons for choosing this type of antenna construction were the need for broad band operation with dipole construction and good mechanical strength.

The fact that the whole of the tower of the Chrysler Building is metallic was made use of in designing the antenna, and the elements are spaced so as to use it as a current sheet reflector. Since the elements are attached and mounted through the tower windows the non-metallic window openings seriously distorted the reflection pattern of the antennas. Experiments proved that three 8-in. strips of stainless steel across the outside of the windows corrected this effect, but this proved somewhat impractical to accomplish. Placing the strips on the insides of the windows was not satisfactory since the thickness of the walls caused the windows to form cavities which destroyed the desired reflection characteristic. The final solution was to cover the main windows completely with a sheet of stainless steel, and to place a strip of steel over the smaller ones.

KCRG-KRCK Installation Keynotes Flexibility

Stations operate as independent dual outlets whose individual facilities may be combined to permit simultaneous programming

By: KENNETH M. CALDWELL & *ROBERT D. ESSIG*
Chief Engineer KCRG-KCRK *Engineer, Collins Radio Co.*
Cedar Rapids, Iowa

STATIONS KCRG and KCRK, AM and FM outlets operated by the Gazette Co., in Cedar Rapids, Iowa, are somewhat unique in that from the beginning facilities were laid out for completely independent dual operation on both AM and FM. The AM transmitter operates on 1600 KC with a power of 5 KW while the FM transmitter operates on 96.9 MC with a power of 10 KW into a pylon antenna achieving a radiated power of 48 KW. The antenna system is a three tower array producing a figure eight pattern radiating to NW and SE. During the daytime, however, operation is non-directional. The AM tower also supports the FM pylon and with this radiator in place the effective height is correct for proper AM operation.

The studio layout consists of two main studios, A and B, each large enough to seat an audience; two smaller announce studios, D and E; and an announce studio, C, with a pair of transcription turntables. Control is accomplished primarily by a master control room which overlooks A, B, C and D. An auxiliary control room has control of studio E as well as B. Transcription turntables are also located in these control rooms. The architectural arrangement and placement of windows is such that it is possible to see every studio as well as the Auxiliary Control Room from the Master Control Room.

Speech Equipment

Three consoles are mounted on a unit desk. The left wing terminates all the telephone, intercom, and order wire circuits, and contains monitor selection and volume controls. Two banks of six keys each connect to the various remote line loops. Lifting a key applies ringing current to a circuit. The keys lock in the down position and connect to the telephone hand set, while the neutral position allows cueing program to be sent out on the remote lines. Indicator lamps above each key work in conjunction with ring-down relays to signal an incoming call. Two cueing amplifiers are provided, one for each of the key groups.

Three Collins consoles handle all the speech equipment switching and preset selecting of studios. Left to right: telephone, line, master control and preset switching consoles

Provision is made for simplex control, but these circuits must be connected with patch cords. Two twist keys on the console connect to repeat coil center taps. In this way DC can be applied between the telephone line pair and ground for the operation of a relay at the remote point. Such a relay can operate signal lamps for cueing the remote engineer, or it can even be made to control the AC power to a fixed gain remote amplifier at a regularly used or permanent installation. In addition, several three-way utility repeat coils in the master control racks are available for multiple distribution of remote programs.

The center section is the speech input control proper, and has ten fader positions plus two master faders; one for each of the two outgoing channels from the console. A key switch above each fader selects the channel it feeds. The fader positions are normalled through jacks to pick up the following inputs: Network, Remote, two transcription turntables in Studio C, one transcription turntable in Master Control Room, two microphones from Studio A, and one microphone each from Studios B, C and D. By the use of patch cords any other desired combination can be obtained, the only requirement being that proper levels are observed. DC control from the fader push key relays is distributed through a selector switch panel so that as inputs are patched around, direct current for the studio monitor speaker silencing relays and on-the-air warning light relays can be routed to the proper point.

Preset Switching

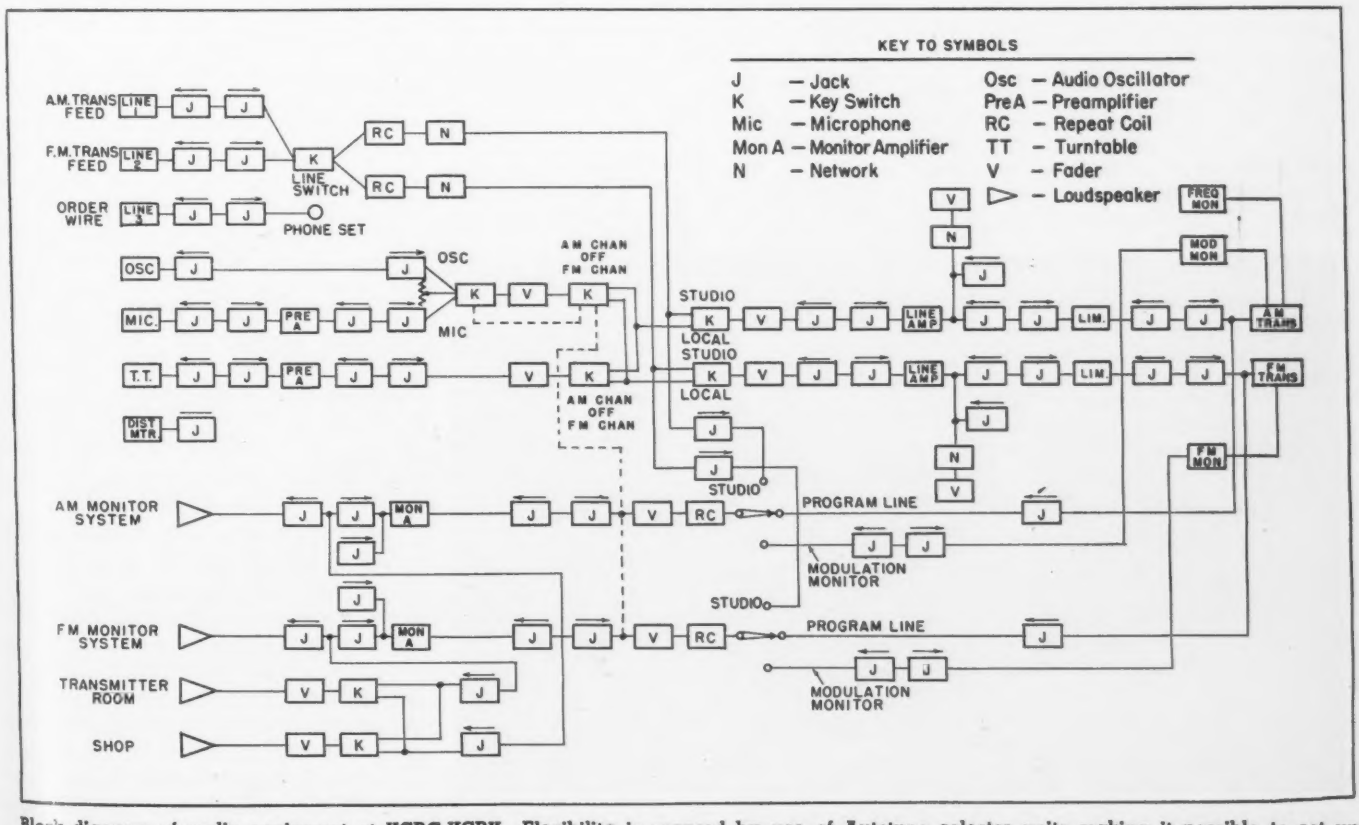
The right wing contains a Preset Switching Console which is the key unit for the entire layout. This console feeds four outgoing lines: KCRG (AM), KCRK (FM), and two additional which can be used for recording, auditioning or network feed. A gain control is provided for each of these and separate volume indicators monitor each line.

The network feed circuit does not normal through jacks, but must be patched. Each of the four output circuits can select program material from any one of ten input channels to the Preset Console. The inputs in use at present are the two outgoing channels from the Master Control Room Speech Console, two outgoing channels from the Auxiliary Control Room console, a circuit from the Music Library's auditioning console, and a direct circuit from the network bus. The other four inputs to the Preset are spares and can be picked up in the jack field. Thus, it is possible to air or record a remote, network, or the Music Library transcription turntables and completely bypass the normal speech input console if so desired. The switching action of this present equipment is practically instantaneous and new conditions can be set up for each of the four line feeds previous to switching time. Touching the operate button then accomplishes all switching action at the same moment. All switching and interlock functions are performed by Autotune selector units, which control banks of rotary switches. The switching cycle is fast, less than one second being required for the most involved change. The main purpose of the relays is to disconnect the outgoing lines from the selector during the switching interval.

Control console for the two transmitters is a single unit located with a clear view of both. It contains frequency and modulation monitors and VI meters for each transmitter

The ease with which complicated switching can be handled with this preset console is a main determining factor in eliminating a major headache in dual AM and FM programming. No particular studios or circuits are reserved for either AM or FM origination. The system is completely flexible. To prevent announcer confusion, since the same staff operates both the AM and FM outlets, illuminated status signs are located at each announce position in Studios C and E and indicate either "KCRG" or "KCRK". The lights are controlled by auxiliary key switches on the consoles.

The disc recording machines are



Block diagram of audio equipment at KCRG-KCRK. Flexibility is assured by use of Autotune selector units making it possible to set up circuits in advance, adjust levels and have everything in readiness, and then place them in operation by pressing the proper selector

located in the master control room. Two recording turntables and a small control console are mounted on a special cabinet. Two separate recording amplifiers are available, so that two programs can be handled at the same time provided the 15 minute time limitation is observed. The console has separate VI meters and gain controls.

All amplifiers for the Master Control Room are rack mounted, and together with the auxiliary apparatus occupy eight cabinet racks each with 77 in. of panel mounting space. Wide use is made of a new type vertical chassis mounting. Various amplifier chassis groupings can be accommodated in a standardized mounting unit, tubes being accessible through a hinged front panel. This entire master control rack assembly is mounted flush with the wall and an overhead bank of recessed fluorescent fixtures provides the illumination. Test equipment includes a low-distortion audio oscillator and a distortion and noise meter. Entrance to the rear of the cabinets is obtained through a door at the right. All telephone line and electric power termination is located in this small room behind the racks. An exhaust blower placed in the ceiling behind the racks carries away the heat generated by the units.

Another unusual feature about this station is that all audio cable runs between control rooms are placed in exposed sheet metal channels secured to the ceiling of the hallway serving the offices and studios. The bottom cover plates are hinged on one side and have snap fasteners on the other, and all cable runs can be altered without the necessity of fishing wires through conduits or cable troughs. The cables are hung on hooks attached to the sides of these channels so that the cable run can be completely exposed upon opening the cover plates and without disturbing any of the wiring. There is plenty of room for adding additional wiring should it ever be needed.

KCRG-KCRK

Technical Digest

Location: Cedar Rapids, Iowa
Frequency: KCRG- 1600 KC
KCRK- 96.9 MC
Power Output: KCRG- 5 KW, DA-N
KCRK- 10KW
KCRK: Antenna heighth above average terrain—310 ft.
ERP—48KW
FM Channel 245

Auxiliary Control

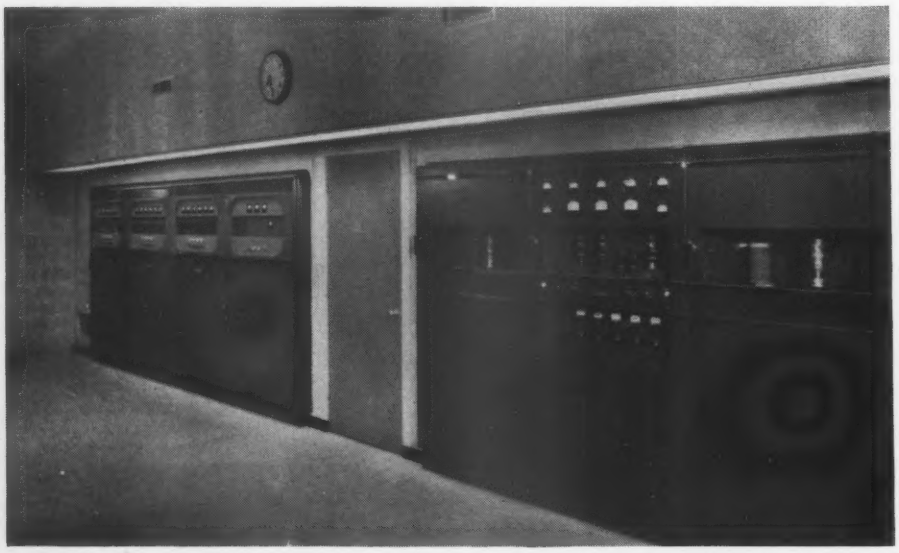
The Auxiliary Control room has a seven-position console, and two transcription turntables. This console also has two independent output channels. A key switch above each fader selects the channel to be programmed from that particular input. Two VI meters are incorporated and two separate monitor amplifiers and speakers are used. Thus, two independent programs can be handled simultaneously if so desired. Each fader position is switched on or off by means of push keys just as is done on the Master Control Room Console. An indicator lamp shows when a particular channel fader is on and programming. In addition, there is a remote operate button on this console for the Master Control Room Autotune switching gear previously described. Thus, it is possible for the Auxiliary Control Room operator to handle a main feed switch independent of Master Control. The preset condition, however, must be set up on the switching unit itself.

A feature common to both control consoles is independent and automatic turntable cueing. As with the microphone channels, on and off switching is done by relays controlled by push keys located above the faders. On the transcription channels, the relays in the de-energized position connect the output of the preamplifiers to the input of a cueing amplifier. A separate cueing speaker completes the arrangement. Thus, a turntable is automatically switched from "cue" to "program" as the transcription channel "on" button is depressed.

The Music Library contains a standard transcription turntable and a small mixing console with VI meter. A monitor speaker is mounted on the wall. The dual channel preamplifier, booster amplifiers, and monitor amplifier for this setup are installed in one of the Master Control Room racks. The output from this console appears as one of the inputs to the Preset Switching Console on the Master Control desk. This makes it possible to air transcriptions directly from the Music Library if so desired. It is also possible by means of patching to bring up the Music Library Console as a remote on either the Master Control Room Console or Auxiliary Control Room Console.

This station has standardized on 250 ohm impedance for all microphones and turntables, and all cord connectors are similarly wired. Furthermore, the turntables have no self-contained preamplifiers and operate at microphone level. This procedure is of great assistance in eliminating confusion and increases the general utility of all equipment. At first glance this seems like a minor detail, but an engineer who has had to operate and maintain an installation with several microphone impedances, and different cord connectors will realize the importance of this uniformity.

All office, building and studio monitor amplifiers are rack mounted in the Master Control Room. Monitor selection in the various offices is done by remote control boxes which control Autotune stepper units installed in the Master Control Room. Each box has a rotary switch for setting up any one of ten monitor channels. A second knob operate a loudspeaker pad for volume. Each box has a rotary switch for



The two transmitters, FM on the left and AM on the right. The plate and modulation transformers are installed in a concrete vault following good engineering practice

setting up any one of ten monitor channels. A second knob operates a loudspeaker pad for volume control.

Transmitter Plant Facilities

The telephone lines feeding each transmitter have been equalized so that their response is flat from 30 to 15,000 cps. ±1 DB. A third line for the telephone can be used for programming in case of an outage on the regular circuit, and a spare equalizer is available for connection.

A single control console serves both the AM and FM transmitters thus providing a convenient centralized operating position. Audio and test racks are located to the rear of the console desk. Facilities are provided for local operation of an announce microphone, a transcription turntable, and a test oscillator. These can be switched to either the AM or FM channels. The console panel also contains frequency and modulation monitors for both the AM and FM transmitters as well as VI meters for the audio inputs of both transmitters.

Three cabinet racks mount all speech input, accessory, test, and monitor equipment. This includes a distortion meter and audio oscillator. Limiting amplifiers are employed in both the AM and FM services.

The FM transmitter consists of three basic units, a 250 watt exciter, a 3 KW intermediate and a 10 KW final amplifier. The carrier center frequency is directly crystal controlled utilizing the Phasitron system of modulation. Frequency multiplication of only 486 times contributes to the carrier stability plus or minus two parts per million. Pressurized dry air is employed in the coaxial line to the radiator.

Three bays comprise the 5 KW AM transmitter with the exception of the crystal oscillator exciter which is mounted on one of the audio racks mentioned previously. The RF power amplifier uses an 892R in a single-ended circuit. The plate and modulation transformers as well as the modulation reactor are located externally, and together with the FM plate transformer are installed in a concrete vault. The AM antenna array and phasing gear are connected to the transmitter with coaxial line, and this too is pressurized with dehydrated air. Also included in the transmitter building are a complete workshop, utility room for heating and water pumping equipment, a lavatory with shower, and a two-car garage.

TELE-TECH's Associated Editors Embody Wide Radio-TV Experience

B. F. Osbahr

J. H. Battison

Bernard F. Osbahr, associate editor of Tele-Tech, has had a long experience in radio as experimenter, manufacturer's trouble shooter, author of radio texts, and radio expert and administrator for the US Army in the European Theatre.

He early showed distinction in radio, physics and editorial work in his high school and technical school days, winning a number of awards and honors. Following lecture and laboratory work on the RCA Institute's faculty, in 1939 he became engineer for RCA at Camden, performing field tests on new equipment to be marketed, preparing technical data and instruction books on new radio and television apparatus, and handling special trouble-shooting assignments at the home office and in the field.

In 1942 he began a course of special lectures to Signal Corps enlisted reserve students at the New York School of Radio, much of the laboratory equipment for which he also designed and purchased. In 1943 he entered the US Army as radio specialist and teacher, with responsibility for maintenance of his regiment's AM and FM communication equipment, as well as instruction of radio men.

After the Armistice, he remained in Germany to supervise procurement of electrical and radio equipment for the occupying forces, later becoming executive in charge of all maintenance activities for the European Exchange Service.

Since returning to the US in early 1948, Mr. Osbahr has been a member of Tele-Tech's editorial staff, handling varied technical assignments, including complete analyses of station WPIX's TV installation and Philco's manufacturing operations.

John H. Battison, formerly assistant chief allocations engineer of the American Broadcasting Company, has joined Tele-Tech as associate editor.

He has had a long and varied career in all fields of radio broadcasting and manufacture. During the two years that he spent with ABC he was concerned with FCC and frequency allocations matters, as well as problems incidental to establishing new FM and TV stations. On his arrival in the US in October 1945, after six years active service as an RAF combat pilot in the European theatres and Atlantic transport flying, he joined the Midland Broadcasting Company, operators of KMBC, Kansas City, as research engineer. Here he was responsible for the conversion of KMBC-FM to high-band FM operation and installation of a new transmitter, as well as television and general research, and facilities improvements, including preliminary planning of KFRM.

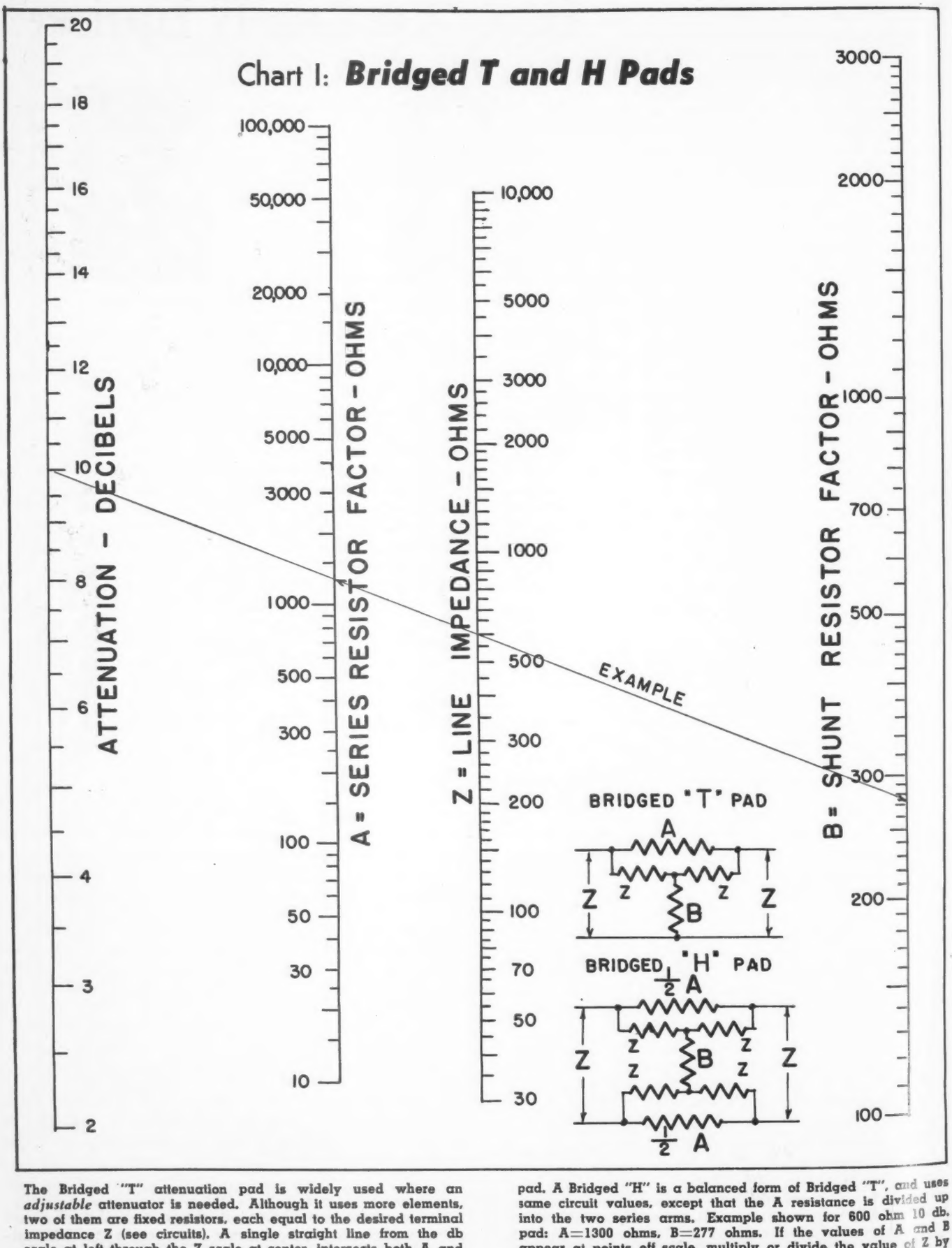
Before the war he was employed for two years as a radio engineer by the British Air Ministry in the Aeronautical Inspection Directorate, and for three years before that as a receiver design engineer by the E. K. Cole Company, makers of "EKCO" radios, and one of the largest radio companies in England.

John Battison is also well known as a writer in the technical press on both sides of the Atlantic. He is a Senior Member of the IRE and a Corporate Member of the British Institution of Radio Engineers. He has presented papers on International and American Broadcasting before both these bodies. His specialized knowledge of, and interest in, Europe and international broad-

(*Continued on page* 59)

Page from an Engineer's Notebook

Chart I: ***Bridged T and H Pads***



The Bridged "T" attenuation pad is widely used where an *adjustable* attenuator is needed. Although it uses more elements, two of them are fixed resistors, each equal to the desired terminal impedance Z (see circuits). A single straight line from the db scale at left through the Z scale at center, intersects both A and B scales at values needed for the Shunt and Series arms of the pad. A Bridged "H" is a balanced form of Bridged "T", and uses same circuit values, except that the A resistance is divided up into the two series arms. Example shown for 600 ohm 10 db. pad: A=1300 ohms, B=277 ohms. If the values of A and B appear at points off scale, multiply or divide the value of Z by 10 as required and apply the same factor to both A and B.

"G" Curves in Tube Circuit Design

New technic provides for determining dynamic operating characteristics of vacuum tube circuits directly and simplifies evaluation of distortion figures. Application to various amplifier and oscillator circuits discussed

By KEATS A. PULLEN, Ordnance Dept., Ballistic Research Laboratories, Aberdeen Proving Grounds, Md.

Part Two of Two Parts

Oscillator Applications

Certain additional technics are advantageous for the study of oscillators. It is first necessary to plot the static non-oscillating load line for the tube under consideration (Fig. 6). From this the locus of limits of the dynamic load line may be plotted by considering the static locus as a midpoint of the load line. If the slope of the dynamic load line is then drawn on the set of curves, a series of load lines may be plotted. Evaluation of average g_m and g_p values and use of the equations for oscillation permit determination of the oscillation amplitude. Formulae for determination of effective g_m and g_p along a load line are

$$\bar{g}_m = \frac{1}{4}(g_{m1} + 2g_{m2} + g_{m3}) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (24)$$

$$\bar{g}_p = \frac{1}{4}(g_{p1} + 2g_{p2} + g_{p3}) \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (25)$$

for class A or AB oscillators. Here g_{m1}, g_{m2} and g_{m3} are the transconductances at the most positive, mean, and most negative biases, and g_{p1}, g_{p2}, and g_{p3} the corresponding plate conductances. (Where the swing is extremely large, an integration method of averaging is to be preferred.)

The most straight-forward method of setting up the necessary operating conditions consists of solution of the operational equation by an iteration method. A frequency near the actual oscillation frequency is selected by inspection or approximation. Usually one offering a simple form is desirable. This is assumed to be the solution, and the operator p is replaced by $p = p_o + \Delta$. Solution for the real component of Δ gives a close approximation to the damping term if p_o has been chosen well. This real component may be equated to zero and solved for g_m and/or g_p. Choice of a load line having the same average value as the g_m and g_p required to satisfy this equation yields the operating condition.

Equations of operation for several typical oscillators will now be considered. Fig. 9 shows the circuit diagram of a magnetic coupled tuned plate oscillator. The differential operational equation for this oscillator is

$$p^3 L_p C g_{mK}\sqrt{L_p L_g} + p^2(L_p C - L_p g_m g_L K\sqrt{L_p L_g}) + p\left[L_p(g_p + g_L) - g_m K\sqrt{L_p L_g}\right] + 1 = 0 \quad \ldots \quad (26)$$

$$g_m = \frac{3}{4K}(\mu\sqrt{C/L_g} + g_L{}^2\frac{L_p}{8\sqrt{L_g C}} - g_L\sqrt{L_p/L_g} \quad \ldots\ldots\ldots\ldots \quad (27)$$

$$\text{where } p_o{}^2 L_p C + 1 = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (28)$$

Eq. (24) gives the required transconductance for oscillation. Choice of the load line having the same average transconductance as called for by equation (27) gives the operating limit.

The capacitance coupled tuned plate oscillator shown in Fig. 10 for an operational equation:

$$p^3[C_K L_p L_g(g_G + g_m)] + p^2(L_p C_p + L_p C_K) + pL_p(g_p + g_L) + 1 = 0 \quad \ldots\ldots \quad (29)$$

$$g_m = (g_p + g_L)\left(\frac{L_p C_p}{L_g C_K} \cdot \frac{2C_p + 3C_K}{2C_p + 5C_K}\right) - g_G \quad \ldots\ldots\ldots\ldots \quad (30)$$

The resulting g_m obtains from (30). Here $p_o{}^2 L_p C_p + 1 = 0$ ..... (31) For proper operation of this oscillator, it is necessary that $X_{L_G} << X_{C_K}$. From this it follows that $\omega_o{}^2 << \frac{1}{L_G C_K}$.

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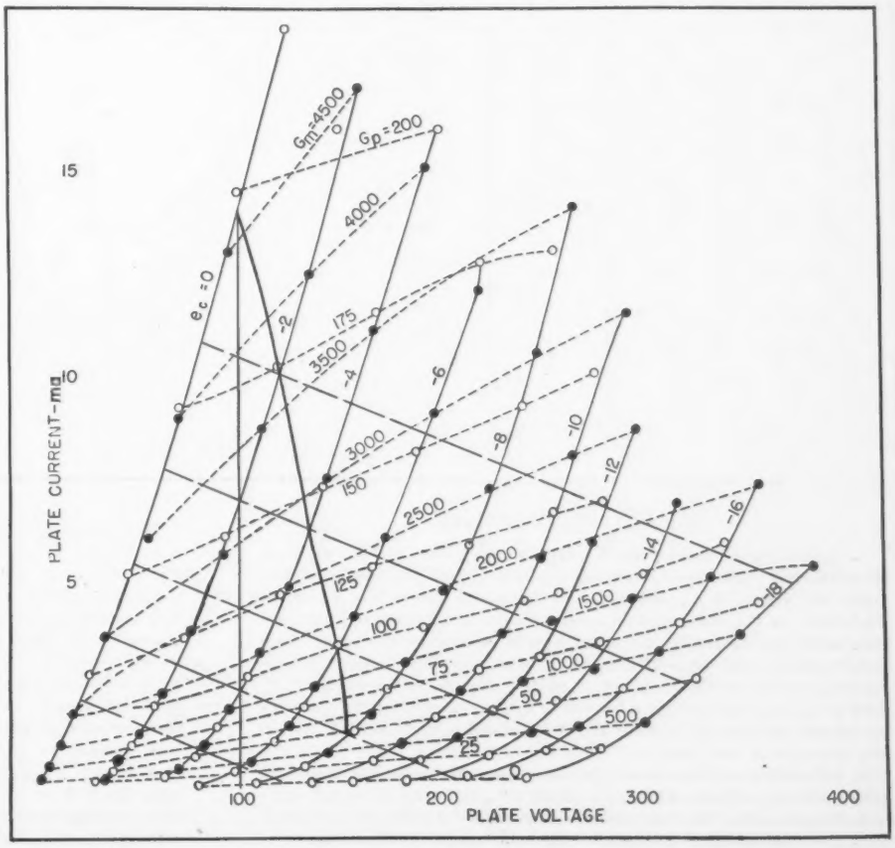
Fig. 6: Curves for determining dynamic load lines of 6J5 tube operating as an oscillator



USE OF "G" CURVES (Continued)

The blocking oscillator is a very interesting circuit (Fig. 11). Since this is a high level device, it is not simple to analyze. However, by this method, integral equations can be set up which can be solved by a step-by-step method. Since the circuit is completely non-linear, the Δ method does not apply. Equation 29 gives the general value of p required.

$$p = \frac{(L_1 g_p - R_g C_2) \pm \sqrt{(L_1 g_p - R_g C_2)^2 - 4 g_m R_g L C_2 - 4 L_2 C_2}}{2 L_2 C_2} \quad \ldots\ldots (32)$$

$$p = \frac{-R_g C_2 \pm \sqrt{R_g^2 C_2^2 - 4 L_2 C_2}}{2 L_2 C_2} \quad \ldots\ldots (33)$$

where $g_m = g_p = 0$. These are the decay exponents effective after tube cutoff. The plate voltage is then

$$e_p = -Z_L i_p = -\int_0^{i_p} \left[R_1 + pL_1 - \frac{p^2 L_2 R}{R_g + pL_2 + \frac{1}{pC_2}}\right] di_p \quad \ldots\ldots (34)$$

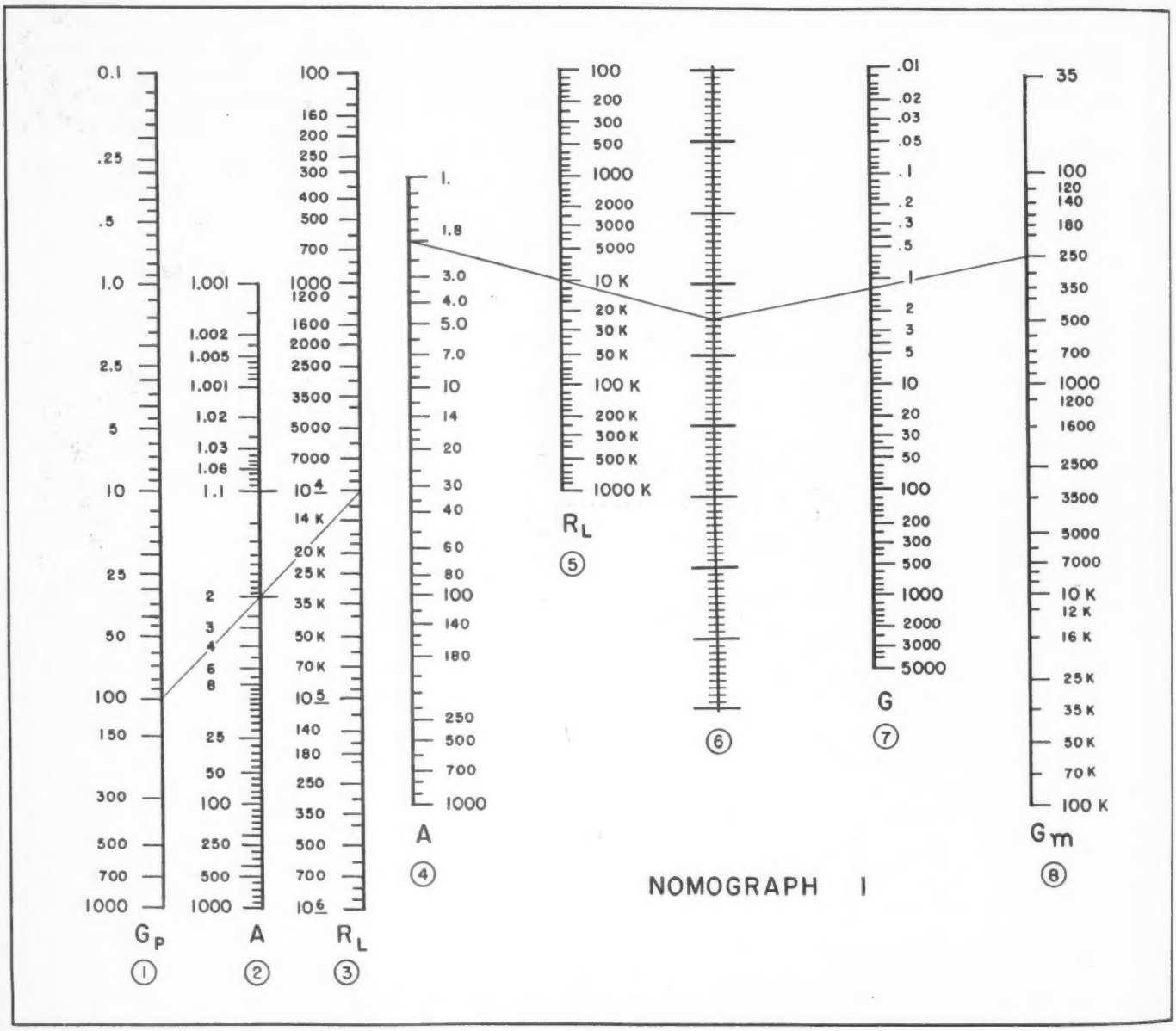
This equation may be integrated step-by-step.

Calculation Nomographs

Performance of calculations has

(*Continued on page* 59)

Fig. 7: (Below) Basic calculation nomograph. Fig. 8 (Opposite): Extension nomograph for degenerative amplifiers and cathode followers.



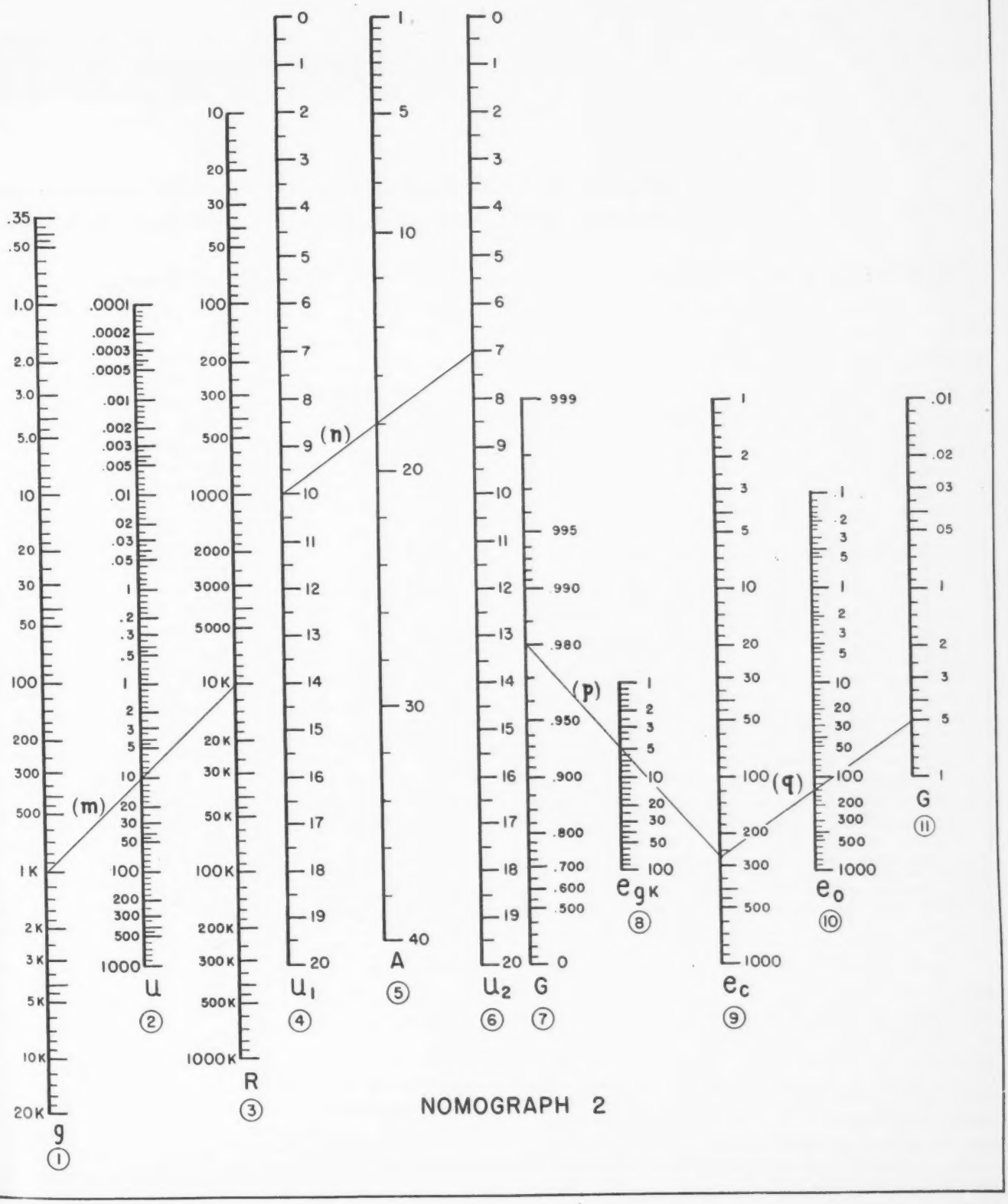
USE OF NOMOGRAPHS

1. ***Calculation of gain of amplifier:*** **Draw load line for tube on plate characteristics curves having lines of constant g_m and constant g_p. Interpolate the values of g_m and g_p at the successive bias values along the load lines on the characteristic curves. From location of R_L value on scale 3 of Nomograph 1, lay straight edge to respective G_p values on scale 1 at left. The value of A for each bias is noted on scale 2. Transfer these values of A to scale 4. A straight line from the value of R_L on 5 gives a point on line 6, which is connected by straightedge with the curves value of g_m on line 8 for each particular bias used for g_p. The gain is read from scale 7.**

2. ***Calculation of distortion:*** **Calculate gains as indicated above at each value of grid bias. Substitute values of gain at the limits of range under consideration into the formula 100 $(G_1 - G_2)/(G_1 + G_2)$. This will give approximate distortion over the range in question.**

3. ***Calculation of gain of degenerative amplifier:*** **A new value of "A" must be found for this case, using chart II. Here $A^1 = 1 + (g_m + g_p) R_k + g_p R_L$. The products $(g_m + g_p) R_k$ and $g_p R_L$ can be found from scales 1, 2 and 3 of Nomograph 2 by placing $(g_m + g_p)$ or g_p on scale 1 respectively, and R_k or R_L on line 3 respectively. Then U_1 or U_2 respectively is read on line 2. Scales 4, 5, and 6 permit calculation of A^1 by taking U_1 on 4, U_2 on 6, and reading A^1 on 5. This value of A^1 is then used on scale 4 of Nomograph 1. Calculation of the gain of the stage requires use of scales 4 through 8 on Nomograph 1 in the same manner as for ordinary amplifiers.**

4. ***Calculation of gain of cathode follower:*** **In this calculation "A" $= 1 + (g_m + g_p) R_k$. Hence U_2 is taken as zero and U_1 calculated as in (3). Again A is calculated on scales 4, 5 and 6 of Nomograph 2, and used on scale 4 of Nomograph 1. Since in a cathode follower the load resistance is the cathode resistor, the value of R_k is substituted on scale**



NOMOGRAPH 2

of chart 1, 5, and the gain then computed in the normal manner.

5. *Choice of operating point:* Calculation of gain at each grid-cathode bias point permits evaluation of gain over the operating range of the tube. The range having permissible amount of distortion can be chosen, and the tube biased to the midpoint of the range. The operating range gives the permissible grid-cathode signal.

6. *Computation of maximum permissible signal:* If in the case of the ordinary amplifier the grid swing allowed from the operating point is multiplied by the average gain, then the plate voltage swing is the product of grid swing by the gain.

7. *Computation of maximum permissible signal-degenerative case:* First the cathode gain of the tube must be calculated with same method as for cathode follower. This gain is used on scale 7 of Nomograph 2. Placing a straight edge from this point to the grid bias swing on scale 8, the grid swing can be read on 9. This is multiplied by the gain to obtain the plate swing.

8. *Computation of maximum permissible swing-cathode follower:* This process differs from computation 7 only in that a straight edge is used to connect the determined value of e_c on scale 9 with the stage gain on scale 11. The output voltage is then read on scale 10.

Designing a TRF

Unusual 15-tube receiver uses three metal rectifiers in "B" and four-stage video amplifier almost equal high gain and

By WALTER H. BUCHSBAUM, Development Engineer, Tech-Master Products Co., 443 Broadway, New York City

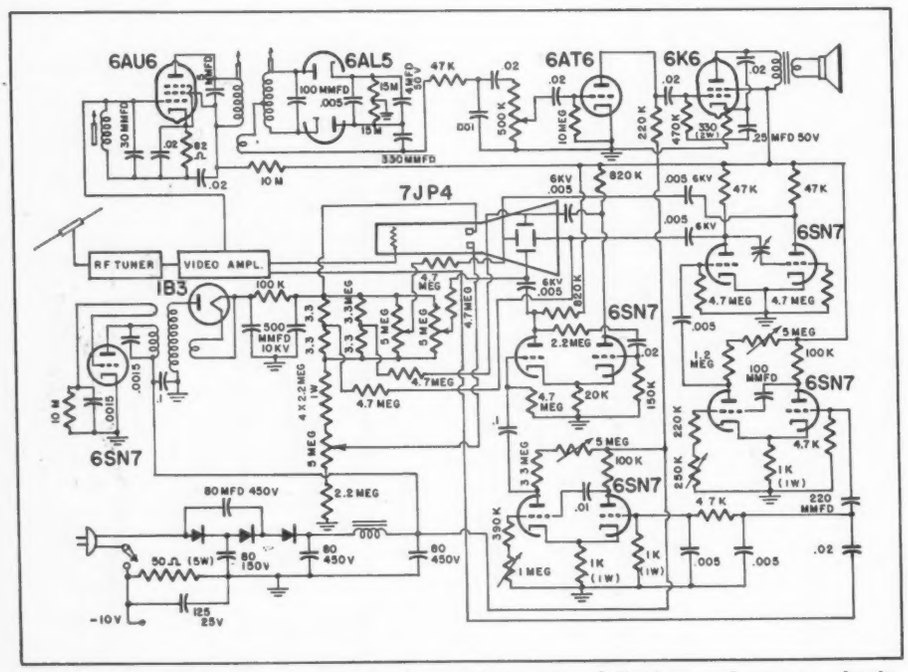


Fig. 1. Intercarrier type sound receiver, electrostatic deflection and power circuits. Three selenium rectifiers are used in transformerless voltage tripler. One 6SN7 used as an RF oscillator and a 1B3 rectifier supply high voltage to the kinescope tube.

TODAY'S television receivers, operating satisfactorily most of the time, are in dire need of simplification. Although prices have already been reduced somewhat, a good television set is still beyond the reach of a very large portion of our population, and no really substantial price reductions can be expected if present design trends continue. The main reason for this condition, is due to the large number of tubes and the expensive alignment procedure required. Some new circuits like the intercarrier (Parker) sound system and the improved horizontal synchronization and sweep circuit using only two tubes are steps in the right direction.

With these limitations in mind the question often asked is why not a TRF type of circuit for television reception? Such a circuit appears to offer much in the way of economical and constructional advantages.

Advantages and Disadvantages

One obvious advantage of a TRF television receiver is the elimination of the IF amplifier section consisting of several tubes and involving costly alignment procedure. In actual operation a TRF set is not likely to become detuned since there is no oscillator drift and no chance of a misaligned sound and picture IF amplifier. On the other hand, the selectivity of a TRF receiver is much less because in a superheterodyne receiver the IF amplifier response curve contributes most to the selectivity and overall response. By comparison the adjacent channel rejection of a TRF receiver is, therefore, much lower, but in television only every other channel is assigned in any one service area so that adjacent channel interference is not generally a problem. In those locations where two different service areas are received and adjacent channels may be present, especially good RF amplifier design is important. The main problem in the design of a TRF receiver, then, is with the RF amplifier stages and their frequency response, since they determine the overall response of the receiver.

To simplify the design problems and keep the cost of components at a minimum, only electrostatic deflection type television circuits were considered. Since the deflection circuit is not dependent on the method of picture signal amplification an electro-magnetic system could also be used, permitting a larger screen cathode ray tube. In designing the sweep section of the experimental receiver care was taken to locate the actual tube sockets and components away from the RF and video amplifiers to avoid any possible interference. Later experiments show that very little harmonic interference emanates from the sweep circuit oscillators, and that this precaution is not necessary. The actual circuit used is shown in Fig. 1.

The sound system is identical to that found in most intercarrier type circuits (Parker system) and consists of a 6AU6 amplifier-limiter with a sharply tuned 4.5 MC resonant circuit in the grid and a conventional 4.5MC ratio detector.

Television Receiver

supply and operates off AC or DC. Two tube RF amplifier performance features obtained in superheterodyne receivers

The 6AL5 double diode is used as detector and the 6AT6 as driver amplifier for the 6K6 sound output tube.

To further cut expenses, a transformerless power supply is used employing three selenium rectifiers in a voltage tripler circuit. The high voltage for the second anode is obtained from an RF oscillator type supply using a 6SN7 as oscillator and a 1B3 as high voltage rectifier. This supply was made quite compact and mounted in a 2½ x 6 x 7-in. shield can on top of the chassis as indicated in Fig. 2. Centering and focusing controls in addition to a high voltage bleeder were mounted on a bakelite panel in such a manner that the control shafts could be turned with an insulated screw driver inserted through holes in the rear chassis apron.

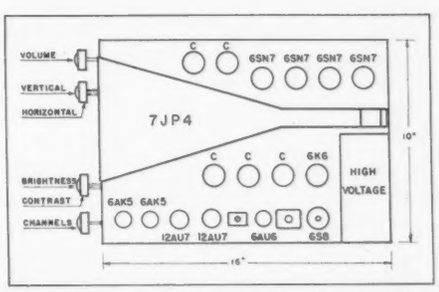


Fig. 2. Top view of chassis showing tube layout, kinescope and operating controls

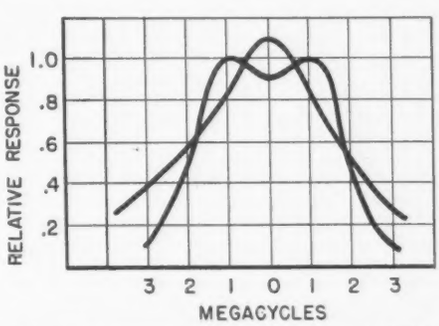


Fig. 4. Frequency response curves of single and double tuned overcoupled RF circuits

RF Amplifier

In order to secure sufficient selectivity and get adequate signal-to-noise ratio, two stages of RF amplification are used. Fig. 3 shows a balanced input circuit consisting of the center tapped RF choke, L1, and condenser C3. This condenser is used to balance out the input capacity of the tube and in its place a larger choke inductance could have been used. Because of the low input impedance, especially on the higher channels, the choke L1 effectively acts as an approximate 300 ohm termination for the antenna lead-in. The balanced input feature was adopted because of its good noise rejection characteristic.

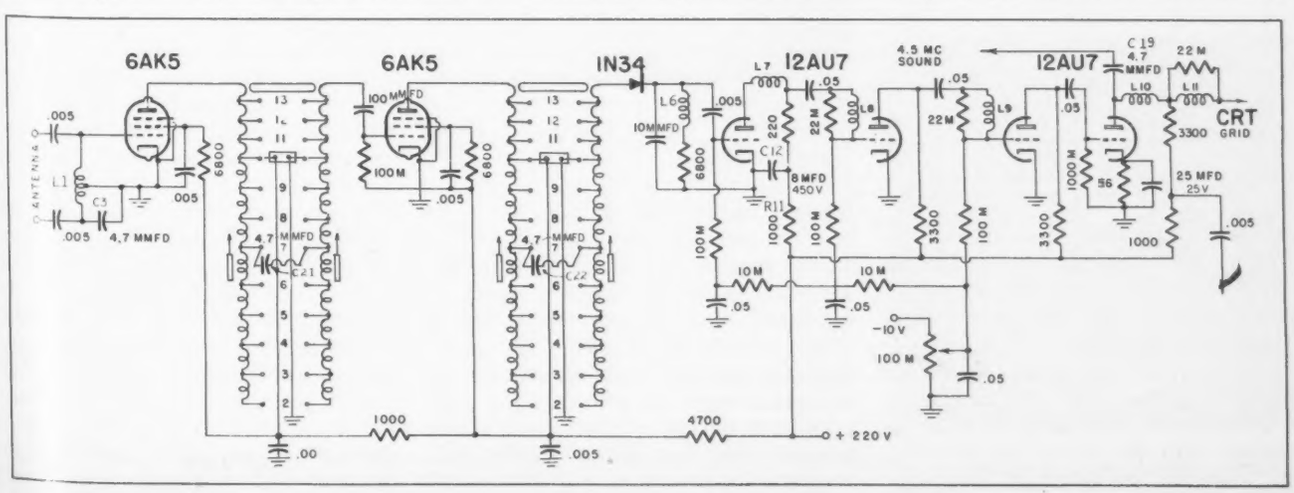
The plate circuit of each 6AK5 RF stage is tuned by a series of coils giving the "tuned line" effect so often found in superhet receivers. A single turn link connects the plate and grid circuit giving the frequency response curve of an overcoupled double tuned stage as shown in Fig. 4. To provide more than critical coupling on the low band an additional condenser (C21 and C22) is connected at the coils corresponding to channel 6.

The need for two double tuned circuits in the RF section deserves special attention because it does represent an alignment and design problem. In regular superheterodyne receivers the selectivity and overall frequency response of the whole set depends largely on the response of the IF amplifier section. A TRF receiver, having no frequency selective stages after the detector, must therefore have enough selectivity in the RF amplifier.

Fig. 4 also shows the frequency response curve of a single tuned circuit. Note the single peak and

(*Please turn to next page*)

Fig. 3. RF tuner and video amplifier circuit. Note use of "tuned line" type of coil connection. The antenna input circuit is balanced by use of a centre tapped RF choke and bypass condenser. The overcoupled response curve is obtained by a single link between plate and grid.



the very gradually sloped off sides. In a TRF circuit this would mean that considerable gain is available for signals on adjacent channels. Superimposed on the single tuned response curve is that of an over-coupled transformer. Now the top portion contains two peaks and, most important the sides of the curve go down much steeper and give almost no gain at adjacent channels. If two such curves are added, which is the case when two RF stages are used, the sides of the overall response curve will appear still steeper. In this design two 6AK5 tube types are employed as RF stages.

Detector & Video Amplifiers

The detector could be any diode, but for the sake of simplicity and compactness a 1N34 crystal was used. In superheterodyne, the largest amount of gain is ordinarily achieved in the IF amplifiers, and in a TRF receiver it can be obtained in the video stages. Provision must be made therefore for passing the whole band of video frequencies up to 4 MC. In this design, frequency compensating networks are used to provide the wide bandpass, as shown in Fig. 5.

Not every stage of video amplification, Fig. 3, has a set of series and shunt peaking coils, because it was found, practically, that this results in a sharp peak at about 3.5 MC instead of providing a straight-line

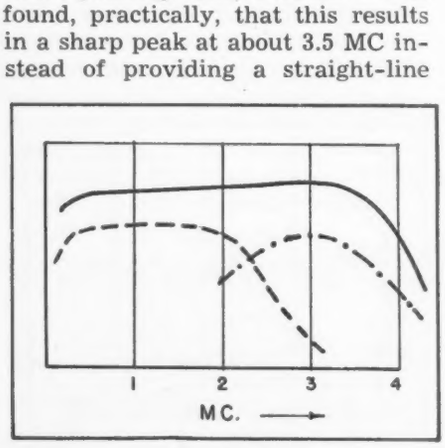


Fig. 5. Compensation produces wide bandpass

response. Only the first stage contains a low frequency compensating network in the plate circuits, consisting of R11 and C12. At the low frequencies C12 has considerable impedance and the actual load resistance is increased by R11. A larger plate load naturally results in greater gain at those frequencies. Fig. 6 shows the effect of this network on the overall response. The high frequency compensating coils L6, 7, 8, 9, 10 and 11 are standard shunt and series peaking coils found in any regular video amplifier.

The stage by stage gain of the entire system of RF and video amplifiers is shown in Fig. 7. The video output tube which is the last triode section feeding the grid of the cathode ray tube, has less gain than the other stages. The cathode ray tube grid has considerable capacity to ground and thus effectively lowers the triode plate load and therefore also the gain.

The video amplifier tubes in this particular design are two 12AU7 dual triodes, but other tubes such as the types 6AU6 or 6AG5 could also be used as voltage amplifiers. If the gain of the first two video

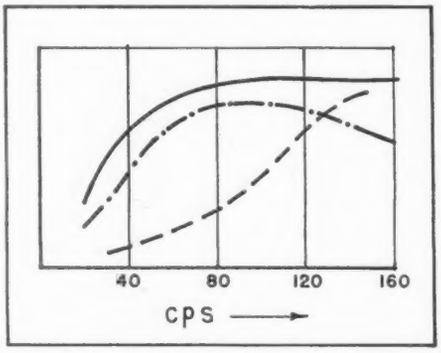


Fig. 6. Effect of low frequency compensation

stages had been raised by means of larger plate loads it would have been possible to use only three triodes and utilize the fourth either for DC restoration or in the sweep section.

The contrast control in this receiver consists of a DC biasing circuit for the video amplifiers from a fixed negative voltage. Although no automatic gain control was used, it is possible to incorporate this feature by obtaining a DC bias voltage from the grid or cathode of the last video stage, or by using the sound detector circuit.

Inter Carrier Sound

The sound system used is the inter carrier type (Parker system) as found in many regular television sets now on the market. The 1N34 detector, being a non-linear circuit element, acts as a converter and produces a beat of the sound and picture carrier. Since their difference frequency is 4.5 MC an IF of that frequency results which is then amplified along with the picture frequencies. Because the video amplifier response does not drop down completely at 4.5 MC the sound IF will receive a sufficient amount of amplification by the time it reaches the last video stage. From there it is fed through C 19 to a sharply tuned resonant circuit in the grid lead of the 6AU6 sound IF amplifier, Fig. 1. This stage acts not only as amplifier but also as limiter

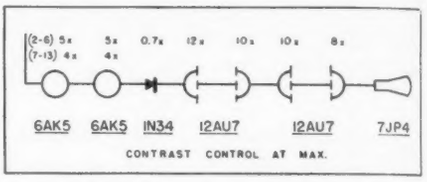


Fig. 7. Stage gains of RF and video circuits

and helps to remove some of the amplitude modulated picture components, especially the 60 cycle vertical synchronizing pulses. A conventional 4.5 MC ratio detector removes the frequency modulated sound signal from the carrier.

Special care must be taken in aligning the RF section to bring the sound carrier to the bottom of the response curve slope. If the sound carrier falls directly on the slope of the curve, the 1N34 will act as a slope detector and the sound signal will appear on the screen of the cathode ray tube. For this reason the bandwidth of the RF section should only be 3.5 MC between half power points.

In the New York metropolitan area, where this model was tested, it gave excellent results on all low channels, with contrast and resolution being equal to most superheterodyne receivers. Its main weakness was the tendency to pick-up interference from strong local radio broadcast stations and almost every other radiation source. After some experimentation this was overcome by completely shielding all video amplifier tubes and their circuits below the chassis. The use of a bottom plate and regular tube shield was found adequate for this purpose.

Some field tests were made in a fringe area location where superheterodynes would only receive pictures with considerable "snow" and a high noise level. The TRF set acted in about the same way, possibly showing somewhat more "snow". An antenna preamplifier or booster was then tried with the superheterodyne, and it seemed to improve the signal-to-noise ratio

somewhat. When the booster was connected to the TRF receiver, the picture appeared to be far superior and to be almost free of snow. It was noted, however, that the tuning of the booster with the TRF set was very critical and slight mistuning resulted in sound appearing in the picture.

From the results obtained to date this circuit appears to be the most suitable, although a model using three 6AC7 video amplifiers also gave good performance. In earlier models, the Q of the tuned circuits in the RF section was too low to permit proper bandpass response in the higher television band. To overcome this, ceramic wavers were used in the bandswitch together with special Hi-Q ceramic condensers. This improved the frequency response curve as well as the gain considerably in the higher television channels.

The main difficulty encountered in the physical construction was with the channel switching arrangement. No suitable commercial units were available, and those constructed suffered from various mechanical shortcomings. Nevertheless, these sets were actually in operation and gave quite satisfactory performance.

In conclusion it can be said that the TRF type of television receiver appears to be quite practical, and that it can be manufactured very compactly at really low cost. More development is necessary, however, in the design of a suitable RF tuner, preferably in the direction of a continuously variable inductance type, permitting easy alignment and simple operation.

New TV "Prompt" System Uses Tape Recorder, Deaf Aids

ONE of the most expensive phases of television—once the station is built and operating—is live programming. Unlike sound broadcasting, TV requires that the players know their lines and not read them from a script as has been done since early AM days. A new application of the old and very well known principle of audio frequency appears to offer TV stations a means of putting on live shows without hours of expensive rehearsal time.

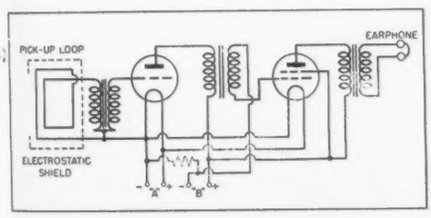


Fig. 1. Circuit illustrating principle of receiver operation. Unit is essentially a two stage receiver with audio pickup loop

It took two producers, Philip Clarke and Jock McGregor, to uncover this application. In excuse for the engineers it may be said, perhaps, that they did not have as much reason as the producers to be aware of this need.

The system, known as Dramasonics Inc., 595 Fifth Ave., New York City, is based on the principle covered by the patents held by the Telesonic Theatre Corporation. The principle of operation is to feed the output of the program amplifier into a loop of copper wire which is laid under the floor covering of the theatre, encompassing the seating areas. For reception, receivers similar in size to a standard deaf aid are used. However, in place of a microphone, a pickup coil is connected to the grid of the first tube. In effect the large floor loop and the small receiver loop constitute a transformer with an air core. Provided the speech currents in the primary are great enough to set up a strong field, good reception anywhere in the theatre is available.

The originators of Dramasonics Inc. have applied this principle to the television studio, and produced a scaled-down version of the audio-induction deaf aid receiver which works in conjunction with a Brush tape recorder. The normal output of the recorder is connected to a matching transformer to match the low impedance of the primary loop to the output tube. The output (primary) loop consists of a continuous piece of #10, or #12 insulated wire looped around the set, behind the scenery and thus out of view of the cameras. The receivers measure about 6 x 4 x 1 in. and are concealed in the clothing of the performer. The earphone is skilfully made up to match the skin tone of the actors and is virtually unnoticeable. After the actors have walked through their parts to familiarize themselves with the action they record their lines on the tape recorder. They then insert their earphones and turn on the receivers. The tape is played back with the recorder output switched to the loop. As the lines are reproduced the actors hear their own voices, and repeat what they hear.

Fig. 2. Earphone invisibility is demonstrated at the School of Radio Technique, New York

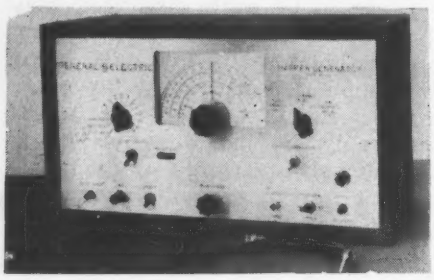
Since there is no RF power generation there is nothing to interfere with the operation of cameras or other equipment. While the circuit of the Telesonic equipment is protected by patents and has not been divulged, the basic principle is well known and is shown in the simplified schematic of operation. The "A" and "B" batteries of 1.5 volts and 30 volts respectively should last for many months. The secondary (pick-up) loop may be shielded electrostatically and consist of about 4,000 turns of 40 gauge wire. Regeneration could probably be used with advantage together with a tuned amplifier which would have an increased gain over the frequency range used.

Fig. 3. Strapped to leg, receiver would be invisible under the actress's costume

New Lab and Test Equipment

Marker Generator

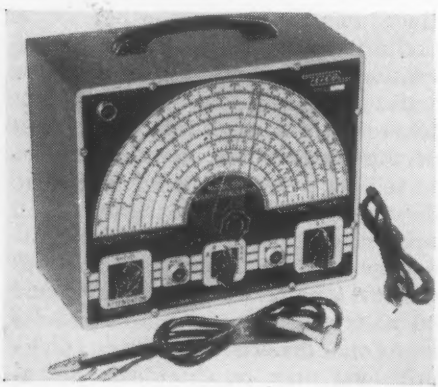
Type ST-5A marker generator has been developed for use in television applications where an accurate source of markers is re-



quired to mark specific frequency locations on a tuned circuit response curve when presented on an oscilloscope. A separate crystal for each television channel can be selected by a rotary switch, with no tuning required. Picture and audio carrier markers are available simultaneously. Markers may be positioned anywhere in the 20 to 50 MC range and as many as 5 markers may be used at the same time. Only one dial setting is required for complete receiver alignment, and pass band and trap circuits can be aligned in a single operation. **—General Electric Co., Specialty Div., Syracuse, N. Y.**

Signal Generator

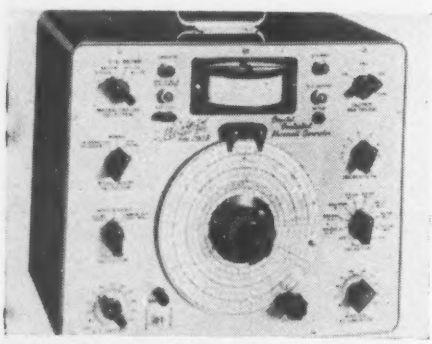
Designed for laboratory, production, and school applications, model 320 signal generator can be used for FM-AM alignment and to



provide TV marker frequencies. It features a highly stable Hartley oscillator with a frequency range of 150 KC to 100 MC with fundamentals to 34 MC. A Colpitts type audio oscillator supplies pure 400 cycle sine wave voltage for modulation. Model 320 is available in kit form or completely assembled and tested.—**Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.**

Signal Generator

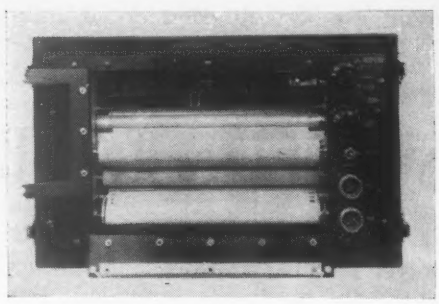
This newly developed signal generator covers both upper channel television and mobile band frequencies on fundamentals.



Known as the 292X, this test instrument, aside from providing all AM, FM and TV frequencies, will measure input and output of units under test. It may be externally modulated from 15 to 10,000 cps and a cast aluminum attenuator minimizes signal leakage. Dimensions of the blue lacquer finish steel case are 14 by 16½ by 8 in.—**Hickok Electrical Instrument Co., c o H. D. Johnson, 10606 Dupont Ave., Cleveland 8, Ohio.**

Rectangular Coordinate Recordng System

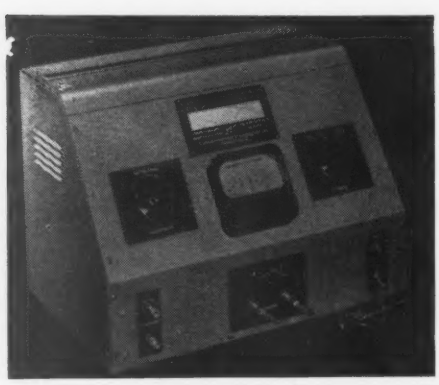
Type 373 rectangular coordinate recording system provides, in Cartesian coordinates, an inked plot of voltage, as a function of the



displacement angle of a measured element. Usable chart width is 10 in., corresponding to a voltage range of 10,000 to 1, or 80 DB. Both pen and paper feed are servo controlled with chronograph paper feed optional. Maximum pen speed is 40 in./sec. At full scale expansion, the maximum paper feed rate is 10 in./sec. Applicable whenever it is desired to record voltage as a function of time or an angle, this system can be used for recording light intensities, sound pressures, and heat levels at writing rates higher than formerly available.—**Airborne Instruments Laboratory, 160 Old Country Road, Mineola, N. Y.**

Capacitance Comparator

An unskilled operator can grade, sort or check as many as 8,000 capacitors a day with model PC-4 automatic capacitance compar-



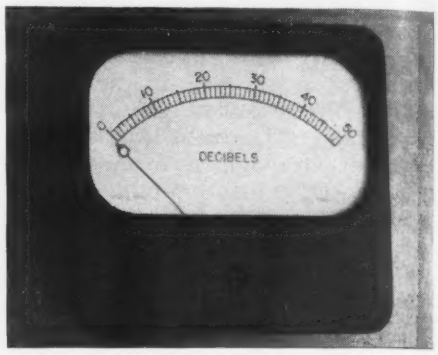
ator, an instrument for calibrating capacitors of any type within an accuracy of 0.2%. Range is from 10 μμf to 1000 μf. The meter is a large-faced, square, DC D'Arsonval type 4-in. Weston product, inclined for easiest vision with minimum parallax. There are 3 meter scales in ranges of—5% to +5% —25% to +30% and —5% to +100%. F.O.B. Cincinnati, $525.—**Clippard Instrument Laboratory, Inc., 1125 Bank St., Cincinnati, Ohio.**

Oscilloscope

Available as a kit or a fully wired and tested oscilloscope, the model 400 is a 5-in. instrument which has a horizontal sweep circuit from 15 cps to 30 KC. Frequency response of horizontal and vertical amplifiers is 50 cps to 50 KC. Input impedance is 1 megohm and 50 μμf. Model 400-K (the scope in kit form) comes complete with all necessary components, tubes and instructions. List 400, $69.95; 400-K, $39.95—**Electronic Instrument Co., 276 Newport St., Brooklyn 12, N. Y.**

Logarithmic Voltmeter

Having a 50 DB meter scale, model 121 Logger reads maximum and minimum program levels on the same meter range and



measures system noise level in silent intervals of program. Feeding output (linear in DB) to a direct writing oscillograph (via suitable amplifier), it will record acoustical reverberation or the efficiency of studio operators in riding gain. Built-in vacuum tube meter has same operating speed as standard VU meter; for more rapid action log output may feed into a cathode ray oscillograph. Unit includes preamplifier and power supply for log unit.—**Audio Instrument Co., 1947 Broadway, New York 23, N. Y.**

Flutter and Wow Meter

A flutter, wow and drift percentage analyzer, known as model 491 (type A) has been designed with a built-in high gain amplifier

and limiter. It was engineered to comply with the tentative standards set by the SMPE for flutter, wow and drift readings. It determines wow, flutter and drift content of all types of 33 1/3, 45, and 78 RPM discs; 16 and 35 mm sound film mechanisms, acetate film recorders, and magnetic wire and tape recorders and playback equipment. Hum, noise, switching surges, and other extraneous transients have no effect upon the reading or stability of the instrument. List $19.40.—**Amplifier Corp., of America, 396-7 Broadway, New York 13, N. Y.**

Field Strength Meter

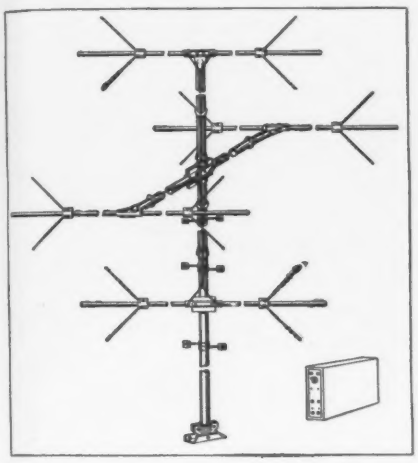
A new field strength meter which is entirely self-contained and weighs only 12½ lbs.

operates in the 200 to 560 KC range. Field strengths between 10 μ volts/meter and 10 volts/meter are read directly, without recourse to charts, curves, factors or computations of any kind. This instrument is simple to operate, and measurements are quickly and accurately made.—**Clarke Instrument Corp., 910 King St., Silver Spring, Md.**

TV & Communications Components

TV Antenna

Type 900 Taco television antenna features 4 driven elements, 2 in the vertical plane and 2 in the horizontal plane, in place of para-



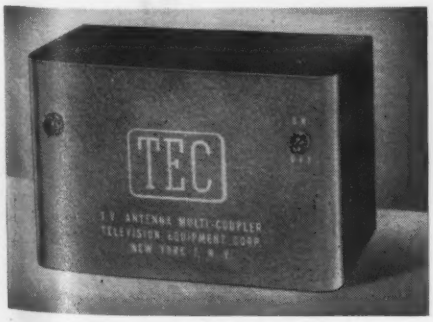
sitic elements, thus giving far greater control of the field problem, and also permitting lobe-switching. By means of the antenna's diplexer network, co-channel interference can be eliminated entirely in many locations where 2 stations are on the same channel or adjacent channels and located about 180° apart at the installation. It also makes possible reception from either direction without the necessity of turning the antenna itself. Front-to-back ratio is extremely high, ranging up to 20:1. The diplexer, which is housed in an attractive case located at the receiver, serves as a matching transformer between transmission line and receiver, eliminating any standing waves due to a mismatch. It also serves as a reversing switch for switching directivity lobes. As reversing is done electrically, nothing is lost in signal strength.—**Technical Appliance Corp., Sherburne, N. Y.**

Miniature Power Pentode

Designed for use as a class C power amplifier, the type 5A6 uses a multistrand filament which will operate in equipment where the battery voltage is expected to range between 5 and 8 volts. The tube is capable of a power output of 3 watts at frequencies as high as 70 MC. It uses the 9-pin miniature all-glass envelop and button stem. Diameter is ⅞ in. and seated height is 2⅜ in.—**Tung-Sol Lamp Works, Inc., 95 Eighth Ave., Newark 4, N. J.**

TV Antenna Multicoupler

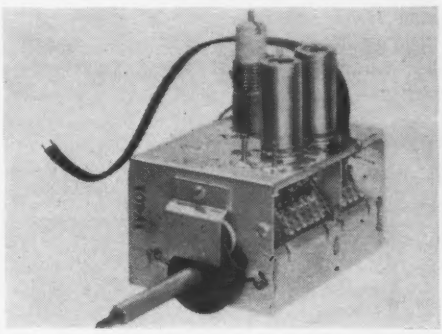
The TEC Multicoupler is a small easily-installed unit which facilitates the operation of 8 TV sets from 1 antenna. As many as 3



Multicouplers may be used in cascade and when such an arrangement exists the simultaneous operation of 24 receivers is possible from 1 antenna. Sets may be tuned independently on any of the 12 existing channels at the same time. The unit contains 8 electron tubes in a special circuit which provides a high degree of isolation between operating sets and does not appreciably diminish the signal received by any one receiver.—**Television Equipment Corp., 238 William St., New York 7, N. Y.**

TV Tuner

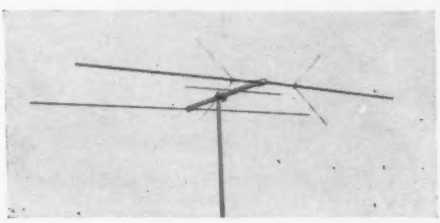
An individual oscillator adjustment screw for each channel, higher sensitivity with fewer tubes, and one control shaft for fine tuning and channel selection are features of



the "Standard Tuner", a television receiver component. Channel inductors are easily interchanged. All 12 channels are covered.—**Standard Coil Products Co., Inc., 2329 North Pulaski Road, Chicago 39, Ill.**

Uni-Directional Antenna

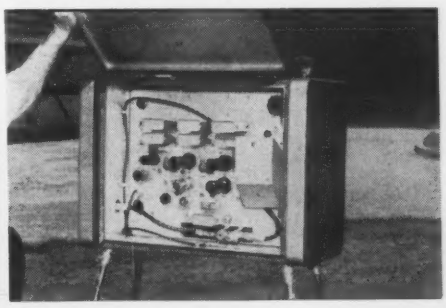
Model 204A1 is a uni-directional antenna for use in locations where both high and low-frequency stations are in the same general



direction. A feature of the 204A1 is the unique RCA "V" attachments for uni-directional reception on all channels. A more uniform response is provided on channels 2 to 6 than a folded dipole, and response is unusually flat over each of the 2 television bands.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**

TV Link Equipment

Telelink equipment for 3 types of television microwave relay systems has been developed for operation in the 1990-2110 MC band. Basic



components include transmitters, receivers and antennas for intercity, studio-to-transmitter, and semi-portable relays. The intercity equipment (type TL-1-B) fills the need for an inexpensive and reliable network between television stations in different cities. Relay sites connecting the stations can be spaced from 25 to 60 miles apart depending on the terrain. The studio-to-transmitter equipment (type TL-1-A) and the semi-portable relay (type TL-2-A) illustrated, for linking field cameras with the studio or transmitter, are both for one-hop transmissions. Transmitter output for the 3 systems ranges from 5 to 10 watts which, by the use of a highly directional parabolic antenna, gives the equivalent of 5-KW transmitter power at beam center. Frequency response is flat to ±1 DB out to 5 MC, with modulation and demodulation linear within ±5%.—**General Electric Co., Transmitter Div., Syracuse, N. Y.**

Sectional Control Console

A universal transmitter control console has been developed which is capable of providing centralized control of all mixing and pri-

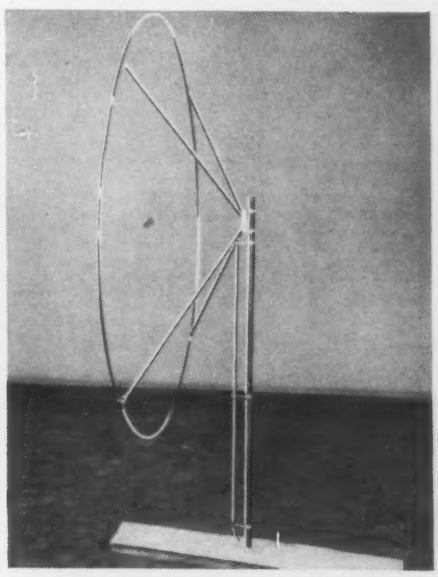
mary switching operations for AM, FM, and television transmitters. Known as the BTC-1, the new console comes in 9 different types of blocks or sections which can be selected and bolted together in various combinations to form a console capable of satisfying the requirements of one or more transmitters of any type. The basic unit consists of an audio control turret and an RF control turret mounted on 2 desk-type sections with removable end pieces. Other units are a 90° desk section, a television control console, a complete turret with blank panel, and a 45° wing turret with blank panel. The console may be built in a straight or in "L" or "U" formations.—**RCA Victor Div., Radio Corporation of America, Camden, N. J.**

TV-FM Antenna

An antenna which can be installed on a window sill without tools, nails, bolts, screws, or cement has been developed for television and FM applications. It is non-directional and covers all frequencies between 44 and 216 mc.—**Public Operating Corp., 100 West 42nd St., New York 18, New York.**

Circular TV Antenna

Designed to overcome the need for 2 separate antennas for high and low frequency television reception the Welin Circle "X"

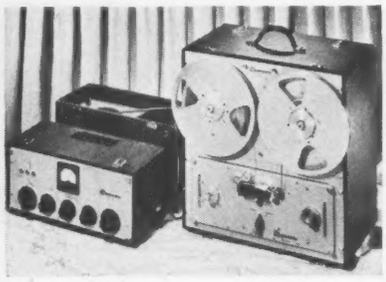


television antenna can be perfectly matched to 72, 150, and 300 ohm lead-in lines, depending upon the receiver input circuit. The whole installation weighs less than 1½ lbs. and the antenna's high signal strength obviates the necessity for stacked arrays and guyed structures. It is supplied in 2 sizes: an outdoor or attic model which measures 84 in. in diameter and retails for $25; and an indoor model with a diameter of 17½ in., priced between $15 and $20.—**Welin Div., Continental Copper & Steel Industries, Inc., 500 Market St., Perth Amboy, N. J.**

Sound & Recording Equipment

Portable Tape Recorder

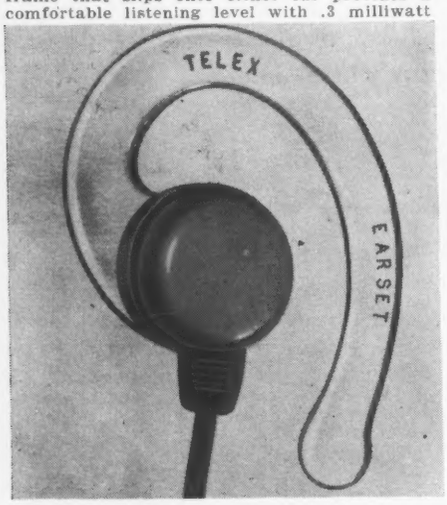
The PT6-MA portable tape recorder, consisting of a basic drive unit and an auxiliary spooling mechanism, is shown in use with the



PT6-P portable 3-channel, mixer remote amplifier. Capacity of its standard NAB 10½-in. tape spools is 64 minutes at a speed of 7½ in./sec. (AM quality) and 32 minutes at 15 in./sec. The PT6-MA has a frequency response of 50 cycles to 15 KC ±2 DB with less than 2% harmonic distortion at full modulation.—**Magnecord, Inc., 360 North Michigan Ave., Chicago, Ill.**

Single-Phone Headset

A single-phone headset with a flat-plastic frame that slips onto either ear provides a comfortable listening level with .3 milliwatt



input and is available for high or low impedances. The "Earset" weighs only 12 oz. and comes equipped with a flexible, removable 5-ft. cord with a standard phone plug connection. The sealed, rust-proof receiver is easily attached to a reversible, clear plastic ear frame.—**Telex, Inc., Minneapolis 1, Minn.**

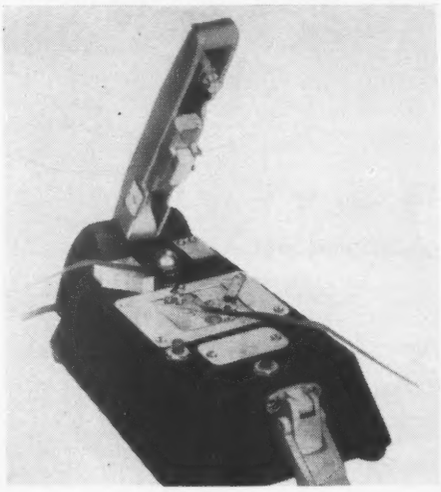
Sound Measuring Equipment

A specially isolated socket tip which effectively separates the microphone clamping structure from the preamplifier extension tube is an exclusive feature of model GA-1002A

sound pressure measurement equipment. This isolation eliminates mechanical resonances that might otherwise result in the extreme high frequency range due to standing waves which could be set up in the preamplifier extension tube under certain conditions of use. The new instrument's dynamic range is such that sound pressures from less than 1 dyne/cm^2 to 20,000 dynes/cm^2 (160 DB level) may be directly measured, and a times ten multiplier is available for extending the upper range to 200,000 dynes/cm^2 (180 DB level). A built-in calibrating circuit permits setting the system gain so that exactly 1 millivolt/dyne/cm^2 is delivered across the 10,000 ohm output circuit.—**Massa Laboratorie,, Inc., 3868 Carnegie Ave., Cleveland 15, Ohio.**

Magnetic Tape Splicer

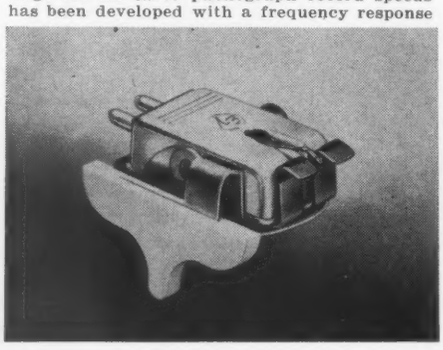
Critical, efficient splicing of magnetic recording tape, without scraping, cementing or employing adhesives is facilitated by the



MT-1 Presto Splicer. Operating principle of the new device is based on a combination of electrically produced heat and precise pressure, applied with an accurately controlled time cycle—producing strong, perfect, diagonal splices. Tape is joined by a plastic weld without adding to the thickness of the tape or using any of the tape material for the weld. No "bloops" are created; the properties of the magnetic recording tape are not affected and the splice is inaudible even with playback amplifier at maximum gain. Each splice takes from 4 to 5 seconds with 5 second cooling off period after splice is made. List FOB New York, $65.—**Prestoseal Manufacturing Corp., 38-01 Queens Blvd., Long Island City, New York.**

3-Speed Cartridge

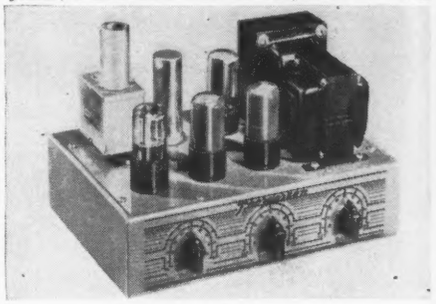
A new torque drive twin-tilt pickup cartridge for all three phonograph record speeds has been developed with a frequency response



which closely follows the NAB standard curve. Output voltage is 1 volt on RD90 test record at 1 KC. Known as the "Twilt", the unit uses a single twin-tip replaceable needle which plays 78, 45, and 33 1/3 RPM records without weight change and with a tracking pressure of only 6 grams on either needle tip. With easy, positive-tilting snap-action, you merely tilt the "Twilt" to select the 1-mil or 3-mil needle-tip for fast or slow speed records. List $12.—**Electro-Voice, Inc., Buchanan, Mich.**

Audio Amplifier

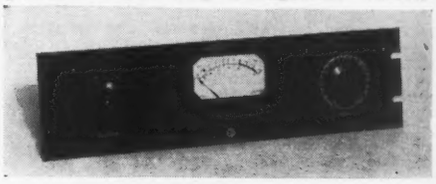
Frequency response from 20 cycles to 20 KC is obtained with the T-32W10 audio amplifier, a new unit with an output of 10 watts



at less than 2% distortion. It has a prewired socket for the T-32WOO pre-amplifier, an additional component that is necessary when the amplifier is used with any of the popular reluctance phono pickups of high impedance microphones. Output for 3 to 4 ohms, 6 to 8 ohms, or 15 to 16 ohms is provided, covering all popular high fidelity speakers.—**Thordarson, Inc., 500 West Huron, Chicago 10, Ill.**

Audio Monitor Panel

Precise monitoring of audio levels is provided by the 630-A1 panel, a unit which also provides a switching arrangement whereby



the same meter, through adequate attenuators, can be employed to coordinate the output signal of 2 independent recording systems. The meter is calibrated at —20 to +3 VU and 0 to 100%. It can be supplied with percent markings above or below the arc. The zero position on the meter may be adjusted, by means of the attenuator, through a sensitivity range of +4 VU to +42. A verner adjustment (screwdriver-type) permits zeroing the meter within ±0.5 DB in steps of 1/10th DB so that it may be calibrated against an absolute standard or matched to other meters in the system.—**Fairchild Recording Equipment Corp., 154th St., & 7th Ave., Whitestone, N. Y.**

Audio Amplifiers

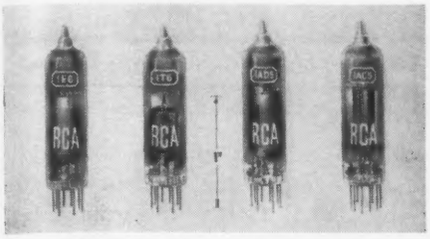
Compact and easily maintained, new AM, FM and television audio amplifiers have been built on trays which fit into a specially de-

signed shelf for mounting in any standard 19-in. cabinet or relay rack. A hinged front panel on the shelf permits quick replacement of amplifiers and rapid tube check from the front of the rack. The amplifiers plug into Cannon receptacles at the rear of the trays. Included are the type BA-1-C pre-amplifier (illustrated) with its type FA-22-A tray, the type BA-12-A program/monitor amplifier with its type FA-22-B tray, and the type **FA-23-A shelf** which will accommodate up to 6 of the pre-amplifiers and up to 4 of program/monitor amplifiers.—**General Electric Co., Transmitter Div., Syracuse, N. Y.**

New Parts for Design Engineers

Subminiature Tubes

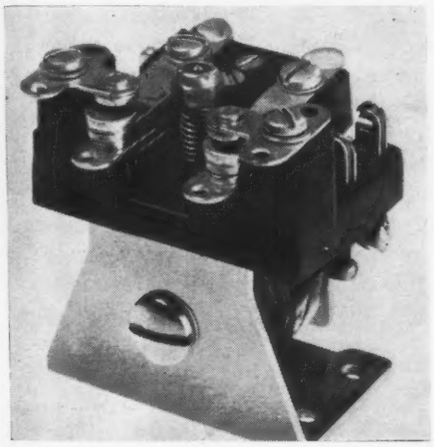
A line of subminiature tubes has been developed consisting of the following types: power pentode (1AC5); sharp-cutoff pentode



(1AD5); pentagrid converter (1E8); diode-pentode (1T6). These 4 tubes provide a complete complement for the design of very compact, light-weight, portable receivers operating in the standard AM broadcast band and having extremely low A-battery drain—only 0.040 amp. per tube. Constructed with a very small glass-button 8-pin base sealed to the glass bulb, these subminiature tubes have a seated length of 1½ in. and a diameter only slightly greater than ⅜ of an in.—**Radio Corporation of America, RCA Victor Div., Harrison, N. J.**

Relay

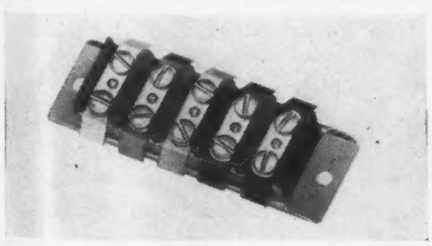
Compact, sturdy, with electrical connections well spaced for easy accessibility, a new general purpose Advance relay is available in



6 contact combinations up to DPDT. Contacts on standard units are ¼-in. diameter pure silver, rated 115 volts AC or 24 volts DC non-inductive. Metal parts are heavily plated with cadmium or nickel and universal wound coil is vacuum varnish impregnated.—**Advance Electric & Relay Co., 1260 West 2nd St., Los Angeles 26, Calif.**

Terminal Block

Vari-colored fiber marking tags are being supplied with the MT built-up terminal block in addition to the white tags which the



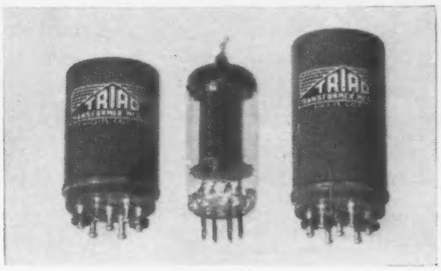
block has been carrying for wire identification. These marking tags assure easy identification of circuits wherever harness wiring or color coded wires are to be used. In addition, the marking tag provides increased insulation to ground. The MT terminal block has ample clearance and creepage distance for use in circuits carrying up to 300 volts, 15 amps.—**Curtis Development & Manufacturing Co., 4524 West Madison St., Chicago 24, Ill.**

Tip Ring Sleeve Jack

The PJ 539 is a tip ring sleeve style jack. A single plug performs the same function, formerly provided by a double plug. The PJ 539 assures a simultaneous break of both sides of the line after circuit is made through plug.—**Audio Development Co., Minneapolis, Minn.**

Miniature Transformer Mounts

Development of 2 new hermetically sealed mounts for audio transformers has been announced. Type JO is 15/16 in. in diameter,



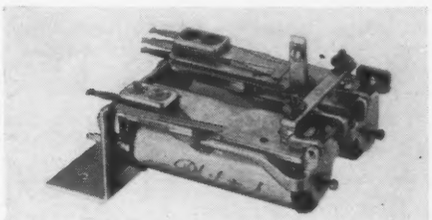
1 13/32 in. in height, and weighs 1¼ oz. Both types are mounted by 2-56 studs on 9/16 in. centers. Illustration compares size with 3S4 miniature tube. Transformers and reactors using this construction can be designed to user's specifications for a wide variety of low level, low power applications.—**Triad Transformer Mfg. Co., 423 North Western Ave., Los Angeles 4, Calif.**

Voltage Regulator

Model 3000 line voltage regulator is a 3 KVA AC unit which has been designed to fill in the gap between Sorenson's 2 KVA and 5 KVA models. Input voltage range of model 3000 is 95 to 125 volts and output voltage range is adjustable between 110 and 120 volts. Regulation accuracy is 0.2%. Harmonic distortion never exceeds 5%. This unit is manufactured primarily for relay rack mounting but can be obtained mounted in a metal cabinet.—**Sorenson & Co., Inc., 375 Fairfield Ave., Stamford, Conn.**

Interlocking Relay

Known as the 30500, a new interlocking relay has been developed consisting of a pair of type 2 Phil-trol relays. Interlocking relays

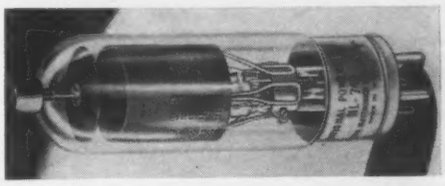


can be supplied for operation on AC or DC. When the lock up relay is energized, it automatically locks in mechanically by means of a tension spring catch, which holds the armature in the energized position even though the electrical circuit has been opened. When the second relay, known as the release relay, is energized, the lock up relay is automatically released from its mechanically held position. Contacts, which may be supplied in single or twin types, are made of various precious metals having ratings as high as 6 amps., 110 volts AC, noninductive.—**Phillips Control Corp., 612 North Michigan Ave., Chicago 11, Ill.**

MORE NEW PRODUCTS ON PAGES 60 & 61

Thyratron

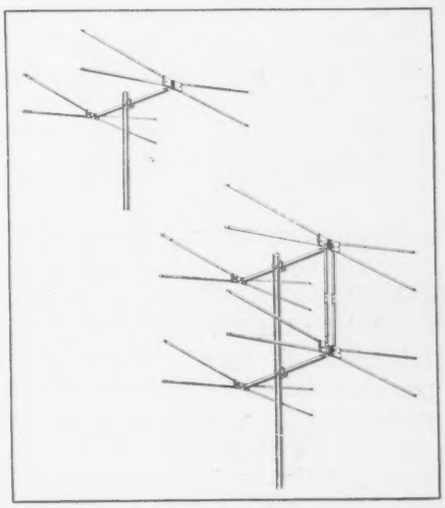
A quick-heating, low-cost thyratron (type NL-740) has been designed as a heavy duty firing tube for use with ignitrons. It has a 50-



amp. peak current rating. The NL-740 is gas and mercury filled for quick-starting and constancy of characteristics within wide temperature limits. Other rating details are: filament voltage, 2.5; filament current 16 amps.; peak inverse voltage, 1250 volts; DC current output, 4 amps.—**National Electronics, Inc., Geneva, Ill.**

TV Antennas

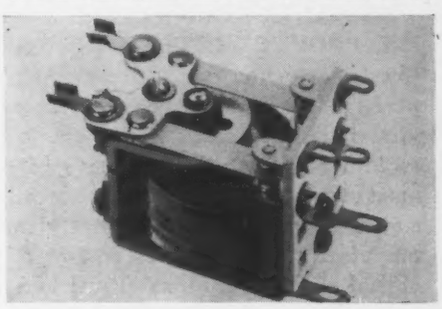
Known as the "D-Xer" series, a new television antenna line has been developed which embraces a 15° broadside tuning angle and



has a good front-to-back ratio on all TV frequencies. A specially engineered wrap-around crossarm clamp employing angular compression U-bolt, provides 4-point support of structural members. The crossarm is not stamped, swedged or machined in any way and thus retains its original shape and strength. A unique element bracket support securely grips dipoles and reflectors. Installation time is less than 60 seconds.—**JFD Mfg. Co., 6101 16th Ave., Brooklyn 4, New York.**

Antenna Relay

An efficient, inexpensive 300-ohm transmit-receive relay for antennas has been developed with silicone glass material for insulation on



the armature and stationary contact assemblies. Proper line spacing is maintained by solder lugs extending from the armature blades and front. Tests on reasonably flat lines have shown a capacity up to 500 watts RF (measured on input).—**Advance Electric & Relay Co., 1260 West 2nd St., Los Angeles 26, Calif.**

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by Tele-Tech's Washington Bureau

CONGRESS GOES OUT LIKE LAMB FOR FCC, RADIO—As has happened in the fifteen years of the existence of FCC almost in every session of Congress, the attacks and blasts against the Commission and against certain leading segments of the broadcasting industry—and in the past two years television—, which have bobbed up on Capitol Hill from important Senators and Congressmen, generally add up to naught in results. This is the situation as the first session of the 81st Congress winds to a close. Even the series of charges about television and against the manufacturers for not informing the set-buying public about the future prospects of color video, which were so sensationally propounded by Senator Johnson, Chairman of the Senate Interstate Commerce Committee, have withered away.

POSSIBLE PARTIAL LIFTING OF TV "FREEZE"—Partial lifting of the television freeze through an engineering co-channel separation plan which was recommended by the Television Broadcasters Association to bring about the opening of television in full flower in 11 market areas of the Rocky Mountain and Pacific Coast regions has been indicated by the FCC. Such a move, ahead of the nationwide lifting of the TV freeze, would step up station equipment and set production and would place those sections of the United States on a parity of video progress with the East, Middle West, South and Southwest, it is viewed. Most important steps in the progress of television were instituted by FCC with nationwide revised table of frequency allocations (UHF-VHF) and proposed new rules for television. These proposals and the revised frequency allocations, including provision for color TV, are to be the subject of a significant hearing in mid-August.

SIGNAL CORPS NOTABLE RECORD IN SPREADING PROCUREMENT—In order to gear their productive facilities for any future war emergency so they can perform the same type of notable task of furnishing vital radio-electronic equipment to the armed services as in World War II, the Army Signal Corps has been most consistent and careful in spreading its procurement contracts to many comparatively small radio-electronic manufacturing companies. In fact, a highly authoritative official of the Munitions Board told Tele-Tech's Washington bureau that the Signal Corps had the best record in its awarding of procurement contracts of any branch of the armed services. This achievement may augur a greater concentration of the military services' procurement activities in the Signal Corps because key members of Congress and high officials of the National Defense Establishment are aware of the efficiency and beneficial policies of the Signal Corps in equipment procurement to foster the strength of the nation's radio-electronic manufacturing industry. This subject also was likely to arise at the next meeting of the Electronic Equipment Manufacturers Industry Advisory Committee to the Munitions Board and National Security Resources Board during mid-July.

IMPORTANT MILESTONE FOR THEATER TELEVISION—Next month—by September 2nd—will witness an important milestone in the history of Theater Television. The FCC has called upon Paramount Television Productions and the 20th Century-Fox Film Corp., the only licensees of experimental theater television stations, and the Society of Motion Picture Engineers to submit comprehensive data and statements on frequency needs and plans for the service so that the FCC can formulate rules and standards for a full-fledged nationwide theater television service. The FCC also expects to determine whether common carrier (Bell System) relay facilities can handle TV broadcasts for theater use or whether there is a place for a regular theater video relay service. In addition, the Commission asked the two major motion picture companies and the SMPE for comments on minimum frequency requirements for nationwide, competitive theater TV and what specific frequency bands should be allocated. The FCC stop augurs the expediting of this branch of television during 1950 in a significant manner to the fullest extent feasible from an economic and practical standpoint.

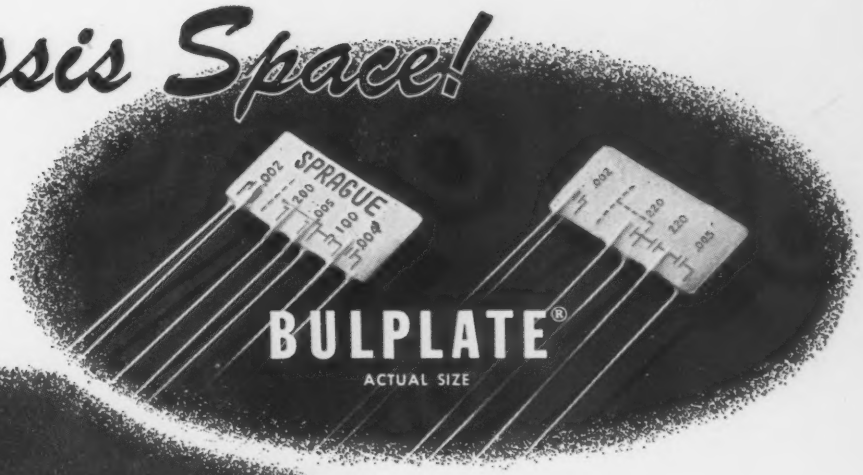
MISCELLANY—Mobile radio services, notably the power and gas utilities and petroleum industry, have put own house in order through frequency coordination committee organizations for new FCC frequency allocations; Miscellaneous Common Carriers, formerly Limited Common Carriers, face extensive hearings this fall on projected systems. . . . Association of American Railroads withdrew petition for reconsideration of FCC mobile radio allocations which removed sole block to the frequency pattern effectuation July 1. . . . ICAO has approved for worldwide usage effective March 1, 1950, the instrument landing system (ILS) and ground-controlled approach radar (GCA). . . . Perennially each summer a Congressional committee launches a probe of FCC activities and nothing comes of these investigations; this time a House Judiciary Subcommittee is delving into processing of AM and FM station applications.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

Save Chassis Space!

and Improve Performance!



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— HERLEC —

● Sprague-Herlec high-K ceramic capacitors for bypass and coupling applications offer the designer of television and F-M receivers savings in both chassis space and in component and wiring costs.

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TELE-TECH's NEWSCAST

FCC Allocates 42 Additional UHF Channels for TV

The FCC in a proposed national Television allocation plan augmented the prospects for the growth of television by adding 42 UHF channels to the present twelve channels which would provide video service for more than six times the number of communities now having television and over four times the number of metropolitan and community TV stations now possible.

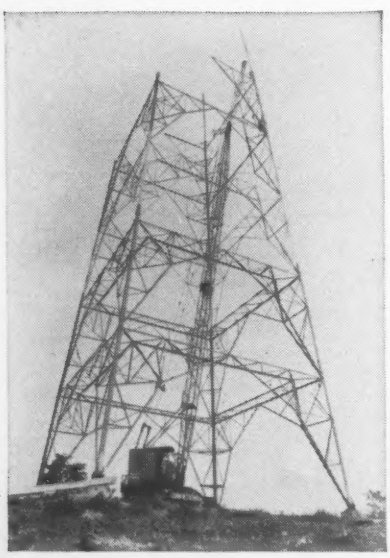
VHF assignments in the present 12 channels would be reassigned under the FCC plan which would make possible 543 stations in 221 cities and communities. The UHF channels will number 42 six-megacycle starting at 470 or 500 MC and will be continuous and numbered from 14 through 55.

The UHF allocation plan will make possible a total of 2245 stations in 1400 cities and communities, not including rural TV stations for which no special allocations were proposed in the FCC report, made public July 11. The determination of whether the UHF TV assignments start at 470 or 500 MC will depend upon the future designation of the frequency space for the Bell System's multichannel broadband common carrier operations.

The present separation of 150 miles for VHF television channels would be increased to 220 miles for metropolitan stations and adjacent channel separation from 75 to 110 miles. On UHF allocations the FCC proposed separation at 200 miles and 100 miles respectively for metropolitan stations and on community channels, 140 and 60 miles respectively.

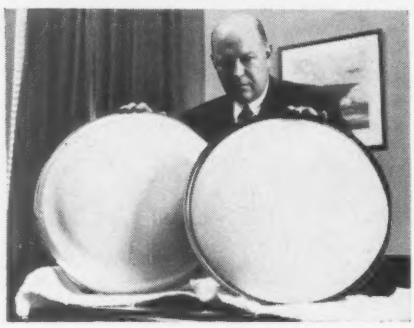
The FCC is to receive comments in opposition to its proposed report and plan by August 8; arguments in opposition by August 19; and will stage a hearing starting August 29 at which proposals on color TV, stratovision and polycasting will be the subjects.

NEW ANTENNA FOR WACE



WACE, Chicopee, Mass. operating on 730 KC. 1 KW day, erects new tower from inside out! Due to restricted level area at the site a vertical jib crane was used inside. After use jib was split and crane driven out.

Du MONT'S 19-IN. TV TUBE



The new short-necked metal 19-in. Du Mont television tube (right) is compared with the old 20-in. cathode ray tube by Dr. Allen B. Du Mont, president of Allen B. Du Mont Laboratories, Inc., Passaic, N. J. Overall length of the new tube is 21½ in. Because of its shorter beam throw, it gives a sharper and more detailed picture than ever before.

Opinions Solicited by FCC on Theatre Television

Letters inviting statements concerning theatre television have been sent by the FCC to the Society of Motion Picture Engineers, Paramount Television Productions, Inc., and the Twentieth Century Fox Film Corp. The Commission requested expression of views covering six specific subjects by Sept. 2, 1949. These subjects are:

(1) What the minimum frequency requirements would be for a nationwide, competitive theatre television service;
(2) What specific frequency bands you would propose to be allocated to a theatre television service; reasons therefore;
(3) The exact functions which would be performed in each such frequency band in a theatre television service;
(4) Whether and to what extent functions could be performed, in whole or in part, by use of coaxial cable, wire or other means of transmission not using radio frequencies;
(5) Whether and to what extent existing common carriers have or propose to have facilities available capable of performing such functions, in whole or in part by radio relay, coaxial cable or wire;
(6) Plans or proposals looking toward the establishment of a theatre television service.

Fire Hazards From Radar

An aircraft company's fire department recently conducted a series of tests to determine the possibility of igniting flammable liquids with radar beams. Tests were made with Type SCR 720 and APG 28 radar equipment and ANF 33 grade gasoline. Ignition of the fuel occurred at distances of less than 25 ft. where metals were close to fuels in the radar beam, reports Tech Notes of the Aircraft Industries Association.

The tests indicate that electrical emfs will be generated in steel tools, mechanical pencils, etc., thus causing sparks. It is possible that light metals might become heated sufficiently to ignite flammable vapors.

Since some types of radar equipment develop about twice as much energy as the equipment used in the tests, the following minimum standards have been suggested:

(1) That no spray painting be done within 100 ft. of radar operations.
(2) That no flammable liquids be stored or used within 100 ft. of radar operations.
(3) That no fuel handling operations be carried on within 100 ft. of radar operations.
(4) That all radar operation ground checks be performed at least 100 ft. from fixed fire hazardous locations such as gasoline loading dock, engine test stand, ammunition storage house, and paint storage crib.

WCBS-TV in New York City is transmitting experimental color TV signals over its assigned channel during non-program hours. Tests are scheduled for 30 days starting July 25.

WMAR-TV in Baltimore and WMAL-TV in Washington will also conduct experiments with color television in the period August 17-19.

Coming Events

August 19-20—Tenth Annual Seminar, IRE, Emporium Section, Emporium, Pa.

August 23-26—American Institute of Electrical Engineers, Pacific General Meeting, Fairmont Hotel, San Francisco.

August 29 - September 1 — Associated Police Communication Officers, National Conference, Hotel New Yorker, New York City.

August 30 - September 2 — 1949 West Coast Convention, IRE, and West Coast Electronic Manufacturers Association 5th Annual Pacific Electronic Exhibit, Exposition Auditorium, Civic Center, San Francisco. (Program listed in July Tele-Tech).

September 26-28—National Electronics Conference, Edgewater Beach Hotel, Chicago.

September 30-October 9—2nd Annual National Television & Electrical Living Show, Chicago Coliseum.

October 17-21—American Institute of Electrical Engineers, Midwest General Meeting, Netherland Plaza Hotel, Cincinnati, Ohio.

October 31-November 2—1949 Radio Fall Meeting (formerly Rochester Fall Meeting). Sponsored by Engineering Dept., RMA; Hotel Syracuse, Syracuse, N. Y.

Italy Buys Recording Equipment from Fairchild

Intended to modernize Italy's national broadcasting system, the largest postwar purchase of recording equipment by a foreign country has been announced by Fairchild Recording Equipment Corp., Whitestone, New York, along with plans for expansion of its research, manufacturing and sales activities.

The $173,000 contract, which has the approval of the Economic Cooperation Administration, calls for delivery of disc recorders, magnetic tape recorders, transcription playback turntables and appropriate accessories to Radio Italiana to bring its recording and broadcasting services to greatly improved levels.

Sherman M. Fairchild, who disclosed the Italian purchase, said that in view of the recording firm's expanding activities the board of directors had appointed Fred R. Driessen president of the corporation. Mr. Driessen has been a management consultant to Fairchild Camera & Instrument Corporation for the last four years. Mr. Fairchild becomes Chairman of the Board.

Tape Recorder Keeps Factory Abreast of News

A robot "announcer," on duty 24 hours a day, is keeping management employes of the Westinghouse Electric Corp., East Pittsburgh, Pa., right up to the minute on company news. By dialing a special number on their in-plant telephones supervisory employes can listen in while a continuous tape reels off the latest developments.

The system works as follows: A script is prepared on the subject to be discussed, then recorded on a standard tape recorder and later transferred to a circular metallic tape which runs continuously. A system of electrical circuits amplifies the message and channels it into the plant's telephone system where 30 calls can be handled at the same time—more than that get a busy signal. The average message runs from three to five minutes and new recordings are made two or three times a week.

Suppressing Radio Interference Caused by HF Welders

A successful method for effectively suppressing radio interference caused by the operation of high frequency stabilized arc-welders is reported in a Signal Corps study now available from the Office of Technical Services of the U. S. Department of Commerce.

According to the report, it was found that with the use of a double-screened room, and with adequate filtering of the power lines at the point of entry into the screened room it was possible to reduce radio interference outside the room to a point where measurement was almost impossible.

Both screening of the welder and filtering of the power line were found essential since radio interference emanated directly from the equipment in normal use, as well as conductively back through power lines.

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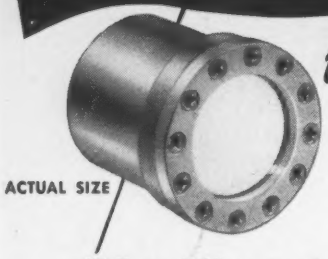

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BOOKS

Elements of Sound Recording

By John G. Frayne and Halley Wolfe, (Electrical Research Products). Published by John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. C., 1949. 686 pages, 483 illus., 6 x 9¼. Price $8.50.

Written for designers and engineers engaged in all fields of audio recording this book, "Elements of Sound Recording," includes generally in its coverage sound-on-film, disc, and the various forms of magnetic recording. Basic subjects, such as electro-mechanical analogies, acoustics, vacuum tubes and audio amplifiers are dealt with in the first few chapters, after which, convenient, and easy-to-use design data for a wide variety of devices, such as: attenuators, filters, equalizers, loud speaker enclosures, dividing networks, and phonograph tone arms are presented. Complex mathematical analyses of design data is resorted to only where necessary for a basic understanding of the problem involved.

Components Handbook

Edited by J. F. Blackburn (MIT). Vol. 17 of the Radiation Lab. Series published by McGraw Hill Book Co. for OSRD of the National Defense Research Committee. 626 pages, price $8.00.

This book lists much of the available information on the properties and characteristics of electronic circuit components. Fixed components—wires, cables, resistors, inductors, and transformers—are treated in the first part, which also includes information on various types of contact rectifiers. The second part deals with electro-mechanical devices: potentiometers, variable condensers, rotary inductors, instrument meters, tachometer generators, relays, magnetic clutches, and piezoelectric crystals. The third part is devoted to vacuum tubes, and includes a brief summary of the properties of cathode ray tubes.

Electrical Transmission of Power and Signals

By Edward W. Kimbark. Published by John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. C., 1949. Price $6.00

This book covers the complete field of transmission-line theory from low frequencies and open two-wire lines, to megacycles and waveguides. For the student, or engineer engaged in extensive transmission-line work it is an ideal book. However, it does not have a great deal to recommend it as an addition to the library of the average radio-electronic engineer since there is little in the treatment or information which is not covered in the usual RF transmission-line sections of radio engineering handbooks. In fact, one or two references in the section on stubs appear to be a little confusing.

The opening sentence of the preface gives the complete purpose of this book—it is a text for students of electrical engineering, and as such is completely adequate.

PERSONNEL

James M. Burke has been appointed chief engineer of Station WAAM, Baltimore, succeeding **Warren Braun,** who has resigned. Mr. Burke was formerly assistant chief engineer of the station.

William R. Kennaugh has been appointed chief process engineer of the John Meck Industries, Inc., Plymouth, Ind., manufacturers of television and radio receivers.

William R. Carruthers, Jr., acoustical engineer, has been named vice president in charge of engineering for the Don Lee Broadcasting System, Hollywood, Calif. **Harry R. Lubcke** will continue in the post of director of television engineering.

Ross Gessford, formerly engineering specialist in cathode ray tubes, has been named chief engineer of the television picture tube division of Sylvania Electric Products, Inc., Emporium, Pa. He joined Sylvania Electric's engineering staff in 1937

W. H. Lamb has been elevated to the general managership of the television picture tube division, newly organized by Sylvania Electric Products, Inc. He was formerly general manufacturing manager for television tubes.

R. A. Hackbush has been elected president and managing director of Stromberg-Carlson Ltd. He has been identified with the Canadian radio industry for many years, first with Canadian Westinghouse Co., then Kolster Radio Ltd.

Irvin Guttman has been appointed sales engineer for the Television Equipment Corp., 238 William St., New York City. He was formerly with the Signal Corps as a civilian radio engineer.

Lawrence F. Parachini has been appointed district sales manager of the Weston Electrical Instrument Corp. office at 6230 3rd St., N. W., Washington, D. C. He joined Weston in 1928, working first on inspection and calibration of instruments, and later as a commercial design engineer.

Dr. Hans Kohler, formerly a member of the research laboratories of the Signal Corps, has been appointed to the staff of the National Bureau of Standards, where he will be concerned with theoretical work in the electronics division. He has conducted extensive investigations in the VHF range, including antenna, wave propagation, transmitter and measurement problems.

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MODEL 202-B

FREQUENCY RANGE 54 to 216 MEGACYCLES

The model 202-B is specifically designed to meet the needs of television and FM engineers working in the frequency range from 54-216 mc. Following are some of the outstanding features of this instrument:

RF RANGES — 54-108, 108-216 mc. ±0.5% accuracy. Also covers 0.1 mc. to 25 mc. with accessory 203-B Univerter.

VERNIER DIAL — 24:1 gear ratio with main frequency dial.

FREQUENCY DEVIATION RANGES — 0-24 kc., 0-80 kc., 0-240 kc.

AMPLITUDE MODULATION — Continuously variable 0-50%; calibrated at 30% and 50% points.

MODULATING OSCILLATOR—Eight internal modulating frequencies from 50 cycles to 15 kc. Available for FM or AM.

RF OUTPUT VOLTAGE — 0.2 volt to 0.1 microvolt. Output impedance 26.5 ohms.

FM DISTORTION—Less than 2% at 75 kc deviation.

SPURIOUS RF OUTPUT—All spurious RF voltages 30 db or more below fundamental.

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LETTERS . . .

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Editors, Tele-Tech:

First: I shall have to introduse myself. I am a VHF and HF editor of the "RADIO TO ONKYO", "radio and acustics" in English meanse. I graduated Hamamatsu technical college in communication section on 1943, and was charged in Navy-labolatory. job was airborn D.F. equipment and some kind of lader, I studyed VHF technic, there. After this war was Over, I discharged and was employed "OHM-SHA" publication company.

We, Japanise engineers, are very thirsty to know American radio, FM, and TV. How are they developing, how much are they using, what kind tubes are mostry using. Many our readers request us every day.

So we would like to know above things with pictuers frome you if you have not any trouble.

Sincialy yous,
Mike M. Fukushi
c/o OHM-SHA Ltd.
1, 3 chome Kanda-Nishiki-cho,
Chiyoda-ku, Tokyo.

Push-button Radios—Then & Now

Editors, Tele-Tech:

On your May cover-chart of "Radio Milestones," you indicate that push-button tuning was introduced in 1937. You are about ten years late on this date as Zenith introduced push-button tuning in 1928. So that there will be no question in your mind about this, I suggest that you go back to the 1928 advertising and you will see that our slogan then was, "Push The Button—There's Your Station."

E. F. McDonald, Jr.
President
Zenith Radio Corporation
Chicago, Ill.

Editors' Note: Commander McDonald is right. Zenith was a leader in introducing push-button tuning. But by 1937 push-button tuning had become practically universal, and most sets, large and small, had some form of push-button or keyboard control. In fact 1937 was the "Push-button Radio Year".

But what has since happened to this sound idea for the radio user's convenience? Since the war very few push-button models have been brought out. We would like to see the push-button vogue restored—on FM sets as well as AM receivers.

Projection TV

Editors, Tele-Tech:

I was much interested in your Tele-Tip in the May, 1949, issue under the heading "Projection TV," I would like, however, to challenge your idea that "projection TV is the ultimate for the home." Certainly it appears to be under present conditions, but it is my personal opinion that these conditions will change and in turn bring about a change in the design of television receivers, particularly as regards desirable size of picture and size of cabinet.

Two of the characteristics of present-day television are (1) the relatively few stations in comparison with radio broadcasting and (2) television's novelty. The first factor limits the number of interesting programs being produced simultaneously. In fact, in many localities only one station is within range. The novelty factor is now evident by the relatively large number of people who gather around a television receiver.

Five years from now, these conditions will have changed. There will be quite a number of transmitting stations within range of the majority of receivers and for each receiver there will be mostly just one viewer. I am also of the opinion that when this time comes the larger homes will contain more than one television receiver, each with a single viewer, and for this situation a smaller picture is entirely satisfactory and perhaps to be preferred. When an individual reads a book or a periodical, he is satisfied with a relatively small picture and in television this may also be true, particularly if it is obtainable from a really low-cost and less bulky receiver. In addition, such a receiver can be placed alongside one's living-room chair or on a desk or table where the individual is working, and thus the controls will be within easy reach. In addition, such a small picture can probably be brighter and thus require no modification in normal room lighting.

You will remember that broadcasting followed a somewhat similar trend. The early good receivers (with speakers) were large console cabinets and a number of people gathered around. Later the "midget" receiver, now known as the table model, entered the picture. Its cost was a small fraction of the larger receiver and its tone was almost as good in quality. It also enabled families to afford more than one receiver and thus each member of the family could listen to his own favorite program.

I predict, therefore, that inside of five years the most popular type of television set will be a low-cost, small table unit with a picture tube only large enough so that its full detail can be seen at arm's length or conventional reading distance. This means 7" diameter or even less. Of course, large picture receivers will be built, but they will not constitute the bulk of the business.

1422 Lowell Road *W. C. White*
Schenectady 8, N. Y.

Exacting Experts with Prolific Fortitude

Editors, Tele-Tech:

Have you seen the definition below? It has a lot of truth.

THE RADIO ENGINEER

A Radio Engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulas calculated with micromatic precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of doubtful reliability and questionable mentality for the avowed purpose of annoying and confounding a hopelessly chimerical group of esoteric fanatics referred to all together too frequently as "Practical Radiomen".

Lee de Forest

Lake Shore Club
850 Lake Shore Drive
Chicago, Ill.

G-Curves

(*Continued from page* 35)

been simplified by preparation of Nomographs. A typical set can be seen in Fig. 7, which makes the basic calculation, and Fig. 8, which extends the technic to degenerative amplifiers, and cathode followers in

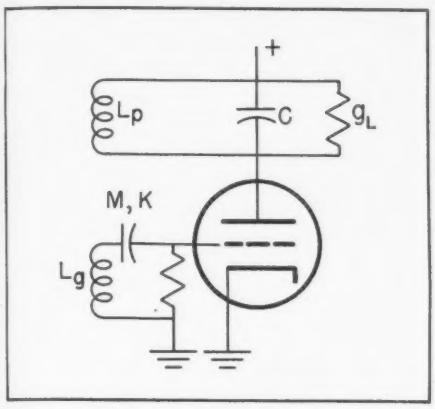

Fig. 9: Magnetic feedback oscillator circuit

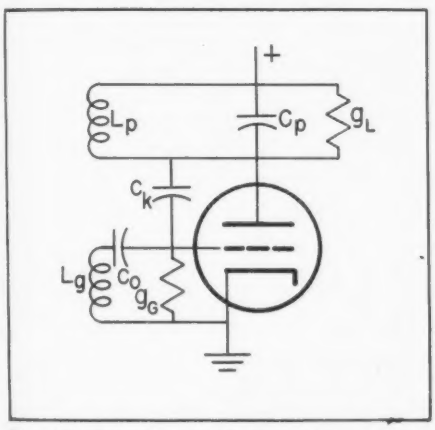

Fig. 10: Capacity feedback oscillator circuit

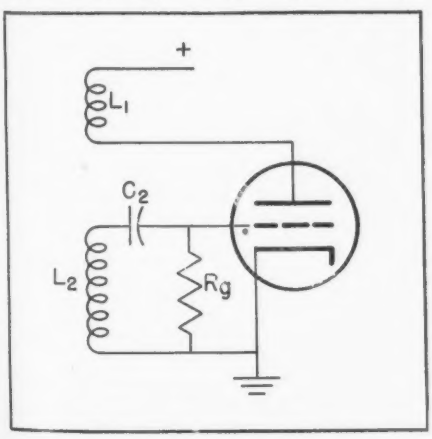

Fig. 11: Blocking oscillator circuit

particular. Actually most of the formulae calculations presented can be facilitated by use of these charts.

As can be seen, the G Curve approach to solution of tube circuits makes available methods for simplification of handling of routine design, and it is particularly useful for special applications of circuits where standard operating conditions cannot be used. Since the non-linearity of the circuit does not interfere with application, stages like Class B and Class C stages can be solved by this method. Whereas distortion normally is difficult to estimate theoretically, this method yields it directly.

It is to be hoped that the tube manufacturers will experiment with this method enough to become aware of the usefulness of the G curve approach. In that case the needed G contours would be added to the characteristics, and the application engineer could make his solution of tube circuits more flexible.

Army Standardizes FM

(*Continued from page* 23)

GRA-6( ) which includes Local Control C-434( )/GRC and Remote Control C-433( )/GRC. When used with the "B" set, the units permit reception and control of the transmitter at distances equal to the voice range of the two-wire line over which they are connected. When used with the four- or five-unit radio sets (AN/GRC-7, for example), the remote control provides for (1) transmitting on either of the two transceivers, or (2) listening to both. It may also be used to (1) turn on or off one of the transceivers, or (2) transmit or receive on one transceiver only. The particular type of operation desired is controlled by the proper set-up at the local control unit. Telephone and signal circuits are provided between the two control units.

Service test models of the components of the standardized series were built by Bell Telephone Laboratories for the Signal Corps on a development contract. Quantity production of the new series for field use has been scheduled,[2] with delivery estimated for 1951.

1. Standardization in the Armed Forces, Col. L. J. Tatom & Capt. H. E. Bernstein, Tele-Tech, June, 1949, p. 22.
2. Signal Corps Procurement, R. Hertzberg, Tele-Tech, Oct. 1948, p. 24.

J. H. Battison

(*Continued from page* 31)

casting bid well to label him an authority on these matters.

Mr. Battison recently returned from a flying trip to England as the guest of the British IRE, having been invited to address its annual convention at London on "Trends in American Radio & Television". It was on the basis of his observations and conversations with British and European engineers during this visit that his article in last month's Tele-Tech was written.

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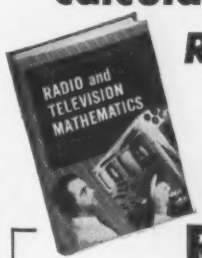

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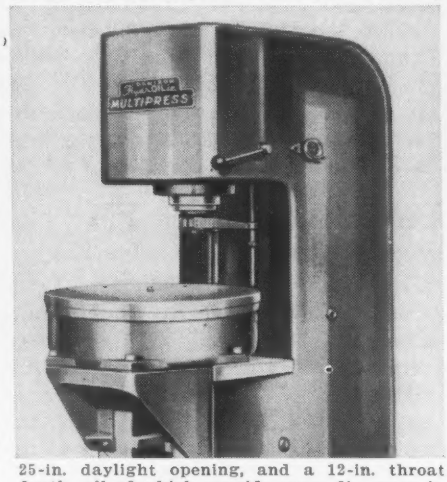
square, rectangular, or other straight sided blanks, shear extremely narrow strips and trim edges of sheets or parts. Cutting range extends from the lightest of materials in plastics, fiber, mica, leather and rubber to heavy gauges of aluminum, cobalt steel, chrome molybdenum, leaded brass, stainless steel and many spring tempered materials. The machine is operated by a non-repeating positive action clutch, controlled by the operator's choice of either the foot bar or hand lever.—**O'Neil-Irwin Mfg. Co., 348 Eighth Ave., Lake City, Minn.**

Oil-Hydraulic Press

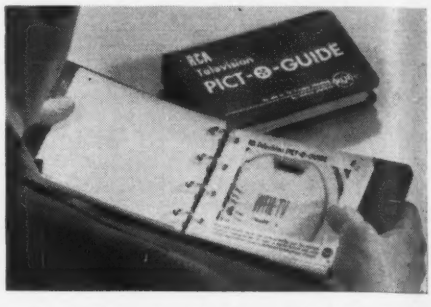
Fast action with high-tonnage pressures under accurate, regulative control are operational advantages of the new 25-ton Multipress oil-hydraulic press. It has a 15-in stroke,



25-in. daylight opening, and a 12-in. throat depth, all of which provide more die space in keeping with its higher tonnage capacities. Approach of the ram to work is variable and can be preset at any speed up to 530 in. per minute. Other operational factors that can also be preset include: ram stroke length, pressing speed and ram pressure.—**Denison Engineering Co., 1160 Dublin Rd., Columbus 16, Ohio.**

TV Trouble-Shooting Aid

A new kind of handbook for television trouble-shooting and service has just been published and is being made available to



users of RCA, Cunningham, and RCA Victor electron tubes. Called the "Pict-O-Guide", the new book is a handy loose-leaf volume of photos showing common operating troubles encountered in TV receivers. Comparison of the picture displayed on the screen of a faulty receiver with a similar picture in the "Pict-O-Guide" helps to identify the source of the trouble. Simple captions under each photo describe the symptoms and explain the causes of the trouble.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**

Solder

Absolutely non-corrosive and non-conductive, "Resin-Five" core solder easily solders such metals as zinc, brass, nickel-plate, copper and ferrous alloys. It is supplied in the usual diameters of .092-in., and .062-in, on 1-, 5-, and 20-lb. spools. Standard alloys are 40/60, 45/55, and 50/50. Other diameters are also available.—**Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill.**

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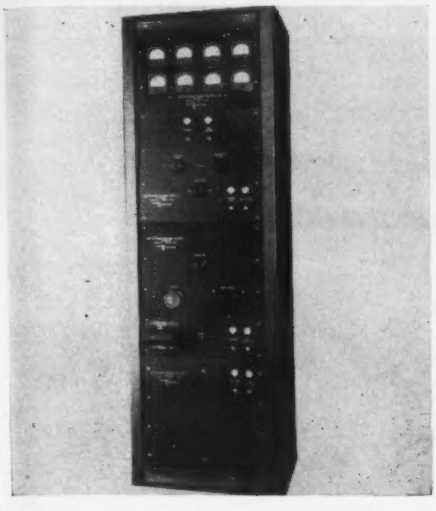
Pressures down to five microns are produced and maintained by the series F Microvac high vacuum pumping equipment, engineered with a completely new exhaust valve assembly for better blank-off pressures and quieter operation. Automatically lubricated, the new machines are available in six different sizes. General construction features prohibit dirt and scale collection and facilitate access to valve assembly for periodic inspection.—**F. J. Stokes Machine Co., 5900 Tabor Rd., Philadelphia, Pa.**

Klystron Power Supply

All voltages and currents for the operation of a high power klystron are supplied by model 910 power supply. It consists of 4



units: beam supply; reflector supply; control electrode supply; filament supply. The first 3 units delivering DC power are well regulated; the filament supply delivering AC power is not regulated. The 4 units are interconnected in such a way that the positive terminal of the beam power supply unit is grounded to the metal enclosure and the chasses. The negative terminal of this unit is internally connected to the positive terminals of the reflector supply, to the cathode terminal of the control electrode supply and to the center tap of the transformer winding delivering filament voltage. In other words, these 3 supplies are normally operated at a high negative voltage with respect to the metal enclosure of the power supply.—**Furst Electronics, 12 South Jefferson St., Chicago 6, Ill.**

Power Supply

Basically new in design, the Electro model B power supply includes new type heavy duty selenium rectifiers with wide range vari-

able voltage control, damped voltmeter and ammeter, 8 power tap adjustments and heavy duty switch. It will deliver from 3 to 9 volts with a rating of 6 volts at 20 amps, continuous and 35 amps. instantaneous from 50 to 60 cycle 115 volt power source. Primarily designed for testing or operating automobile radio receivers and other devices requiring 3 to 9 volts, the model B will also test faulty vibrators, push button solenoids, any 6-volt battery type radio receiver and provide over and under voltage operating conditions for any size auto radio receiver.—**Electro Products Laboratories, Inc., 549 West Randolph St., Chicago 6, Ill.**

DC Power Supply

Unusually good control characteristics, minimum size and weight are features of the model 30 DC power supply, a unit with no

moving parts. It can operate at extreme altitudes and temperatures and will withstand extremes of humidity, salt spray, fungus, and vibration. Input is rated at 110-120 v., 380 to 420 cps, single phase, while the output rating is 300 v. DC, 0 to 400 ma. It passes all USAF specifications (number 32617A for type E-1 static converters).—**Varo Manufacturing Co., Inc., Box 638, Garland, Texas.**

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A new principle used in weaving base Fiberglas cloth has resulted in higher dielectric strength and greater flexibility than the conventional material. This new weave permits better penetration of the insulating varnish between the cloth fibers. It also provides far greater flexibility of the varnished product, while the mechanical strength more than meets all requirements for core wrapp.ngs, field coils, and punchings. OW varnished Fiberglas is available in 3 thicknesses: .007 in., .010 in., and .012 in. It is supplied in rolls 25 and 50 yds. long, approximately 36 in. wide; and tape in widths from ½ in. up, as well as punchings of all kinds.—**Irvington Varnish & Insulator Co., Irvington 11, N. J.**

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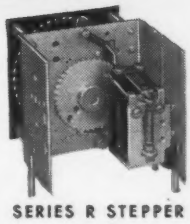

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BULLETINS

Transformers

Thordarson Electric Mfg. Div., Maguire Industries, Inc., 500 West Huron St., Chicago 10, Ill., has just published a new catalog (400H) on its complete line of transformers. Thordarson has designed more than 35,000 different transformers and still has these active specifications on file. (Mention T-T)

Electronic Control Devices

An 8-page bulletin (No. 100,000) has been issued by the Ward Leonard Electric Co., Mount Vernon, N. Y. covering the company's complete line of electric control devices for industrial and commercial control applications. This bulletin describes and illustrates the following components: rheostats, resistors, relays, motor starters, contactors, control accessories and dimmers. (Mention T-T)

FCC Measurement Manual

A "how-to-do-it" manual to assist broadcast engineers in making FCC-required station performance measurements has been published by the Hewlett-Packard Co., Palo Alto, Calif. The 37-page manual is being offered free on request to all radio station chief engineers. It states each requirement for both AM and FM broadcasters, lists equipment needed to make appropriate measurements, and gives in step-by-step detail proper procedures for measuring, recording, tabulating and presenting the required data. (Mention T-T)

New Equipment Transformers

A revised and expanded catalog of new equipment transformers has 16 pages of tables and illustrations that present a complete line of audio and power transformers, and reactors. Included are mounting and construction details, dimensional drawings, frequency response curves for many of the audio units, and a useful table of power-VU-DB relationships. Write to Chicago Transformer Div., Essex Wire Corp., 3501 West Addison St., Chicago 18, Ill. (Mention T-T)

Speakers & Accessories

Catalog 1010-F is a revision of the Jensen 101-E and contains descriptions of cone-type loudspeakers, coaxials, projectors, reproducers, "Customode" and bass reflex enclosures. The Jensen catalog has been published by the Jensen Mfg. Co., 6601 S. Laramie Ave., Chicago, Ill. (Mention T-T)

Soldering Technic

A 24-page booklet on solder and soldering technic has been compiled by the Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill. One of the 7 sections is devoted to a study of the types and properties of soldering fluxes. (Mention T-T)

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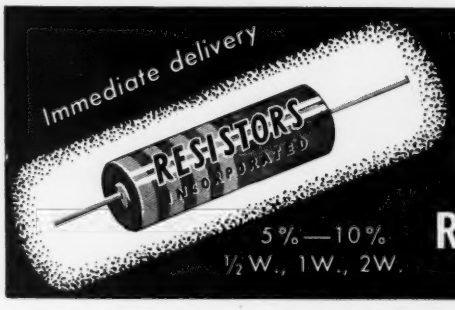

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AUGUST, 1949

TELE-TECH

IN TWO PARTS PART TWO

TELEVISION • TELECOMMUNICATIONS • RADIO

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The better the FM receiver, the larger the areas of good reception. That's why Zenith—with its sensational new line of super-sensitive FM receivers shown on the following pages, greatly extends the area of coverage—far beyond even that shown on the map!

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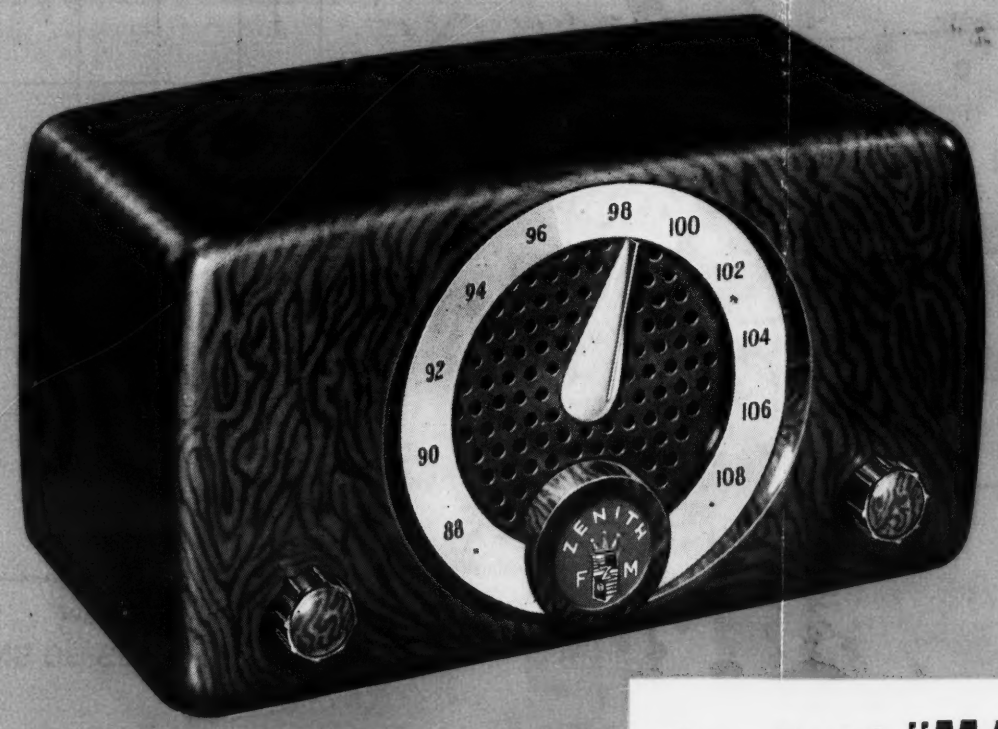

● *Actually 10 times more sensitive than the average of 16 other makes of FM receivers tested!* That's why the New Zenith "Major" opens up a tremendous new radio market for you!

Thousands unable to get satisfactory reception with AM or ordinary FM sets can now enjoy superb long-range reception from many FM stations—glorious in tone and free from static and interference, day or night, even in the worst storms!

The secret of this matchless performance is a new *super-sensitive* FM circuit perfected by Zenith. It's the same *genuine* Zenith-Armstrong FM that leading FM stations use to check the quality of their own broadcasts —*now brought to a new peak of efficiency!* And priced so low anyone can afford it.

Put the "Major" on demonstration in your store right away—and show your customers FM sensitivity and performance they've never experienced before—in any other make set—at any price!

New Zenith "MAJOR"

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First time—genuine Armstrong FM at this low price!

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TELEVISION • TELEC

New Official Coverage Map

GREAT NEW SA
WITH ZE

● The new map inside shows large areas in where consistently good reception is possib

The better the FM receiver, the lar reception. That's why Zenith —with its super-sensitive FM receivers shown or greatly extends the area of coverage— shown on the map!

In many areas where only one or tw heard with some ordinary FM sets, Ze makes possible reception from five, ten

No wonder these new Zeniths oper radio territories for dealers, and undre ing opportunities for both national and teners in many areas where there is r after dark will buy these Super-Sensiti *plete* broadcast service day and night really satisfactory reception has previ with either AM or ordinary FM receiv

Ord Zen

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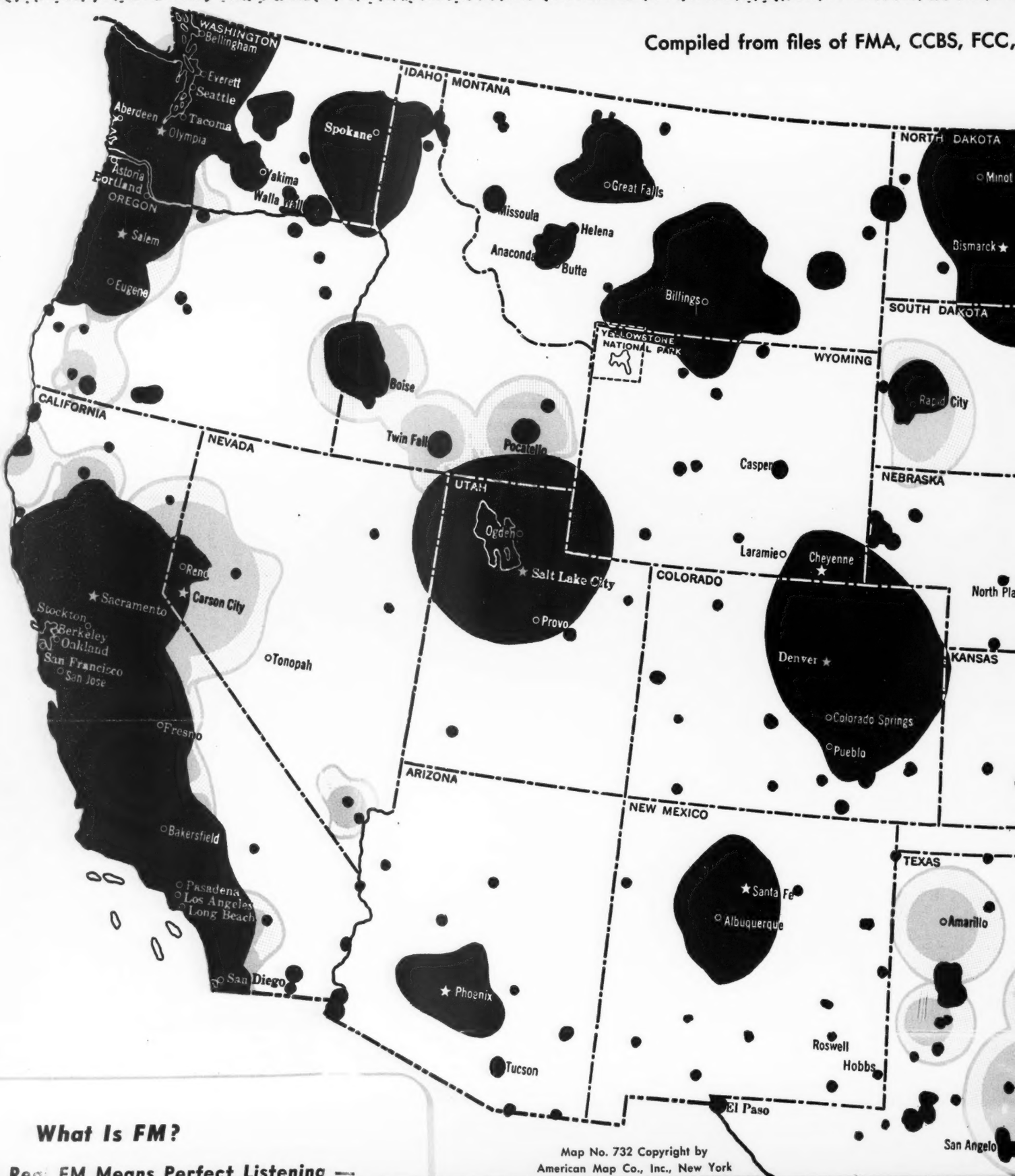
Areas of Dependable Satisfac

Compiled from files of FMA, CCBS, FCC,



What Is FM?

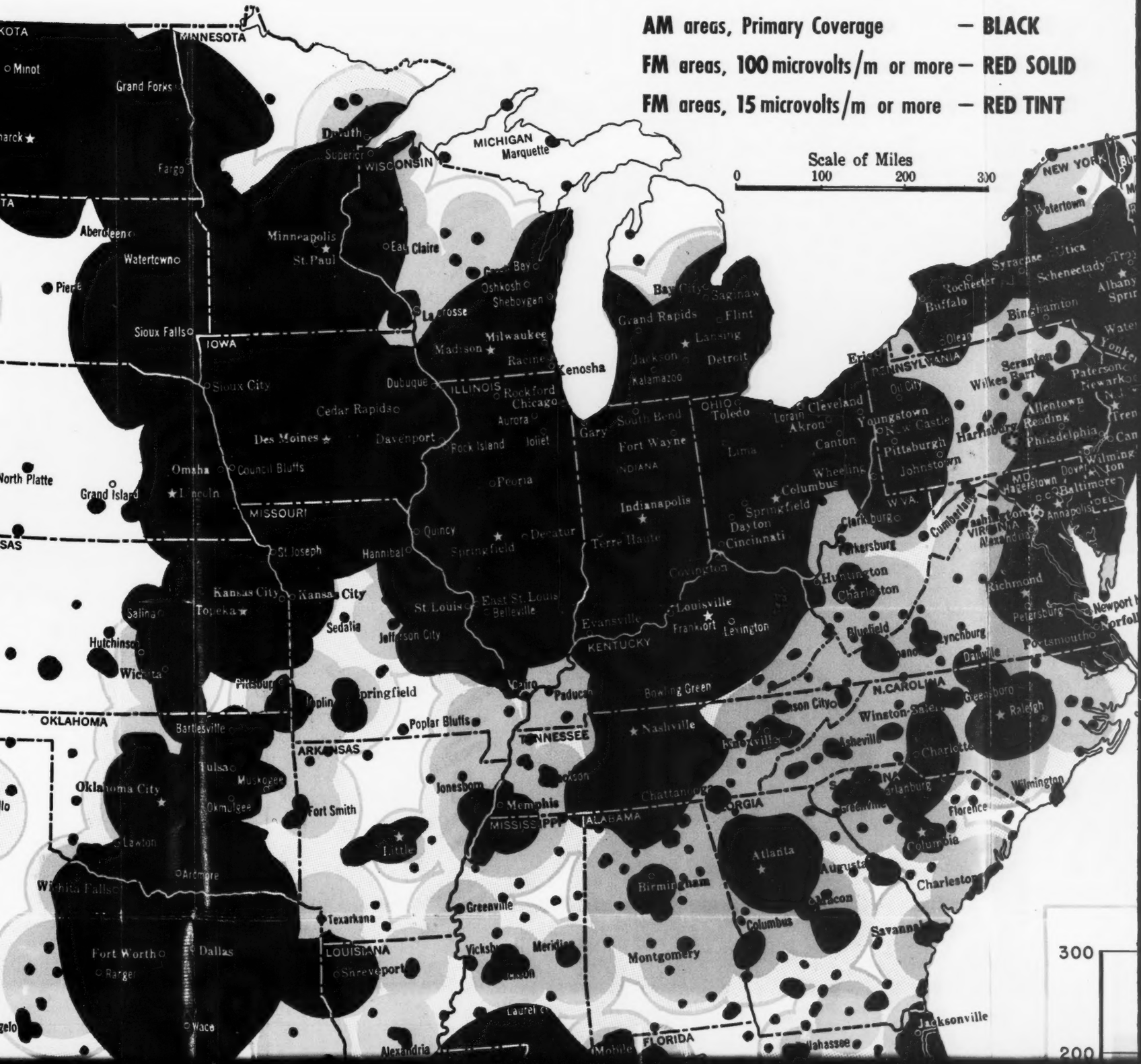
Real FM Means Perfect Listening —

Map No. 732 Copyright by
American Map Co., Inc., New York

actory RADIO RECEPTION -- FM v

FCC, etc.

This chart shows those areas of the United States where dependable satisfactory radio reception can be obtained 90% or more of the available broadcasting time, day and night at all seasons of the year.



# of Dependable Satisfactory RADI

Compiled from files of FMA, CCBS, FCC, etc.

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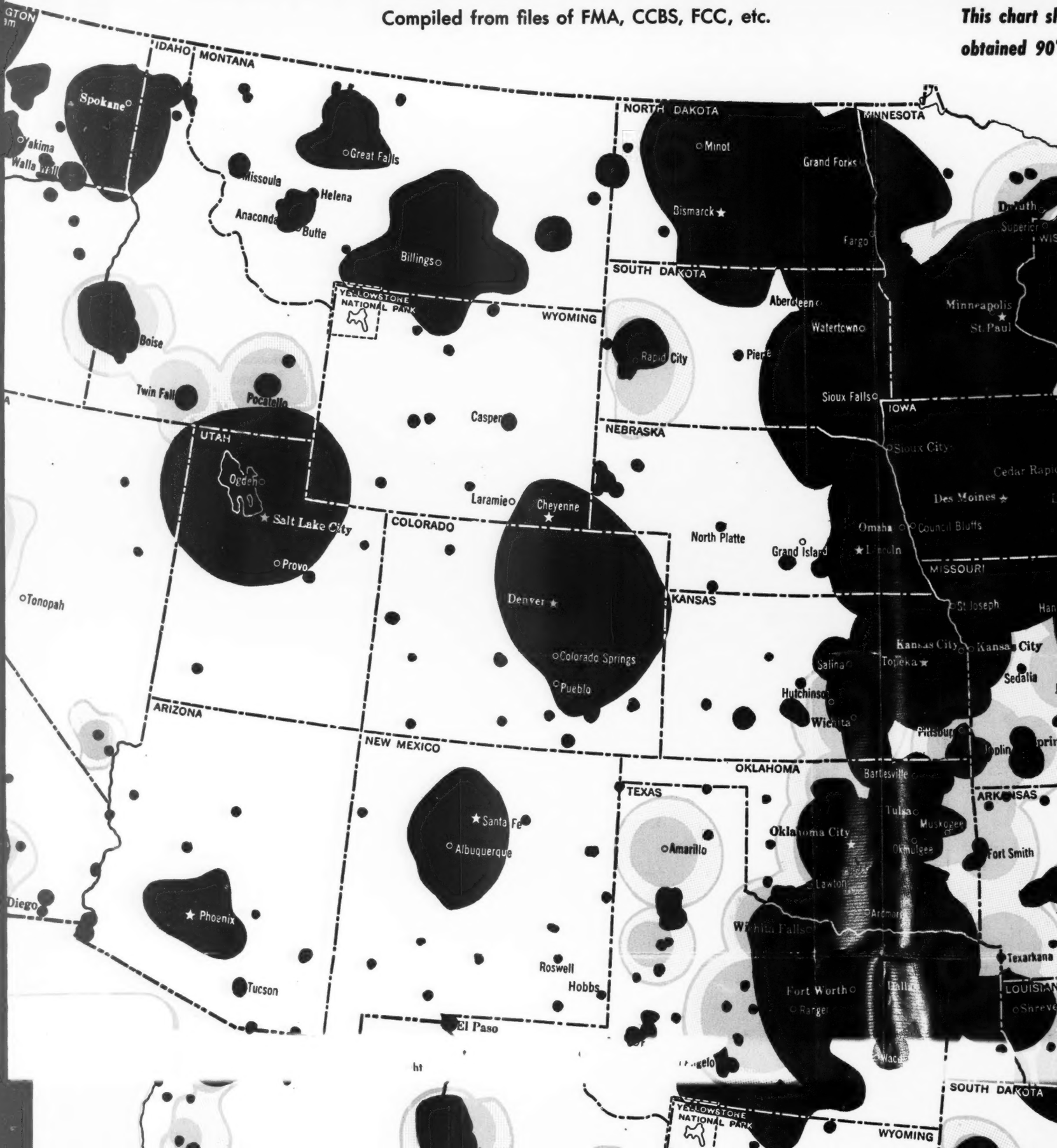


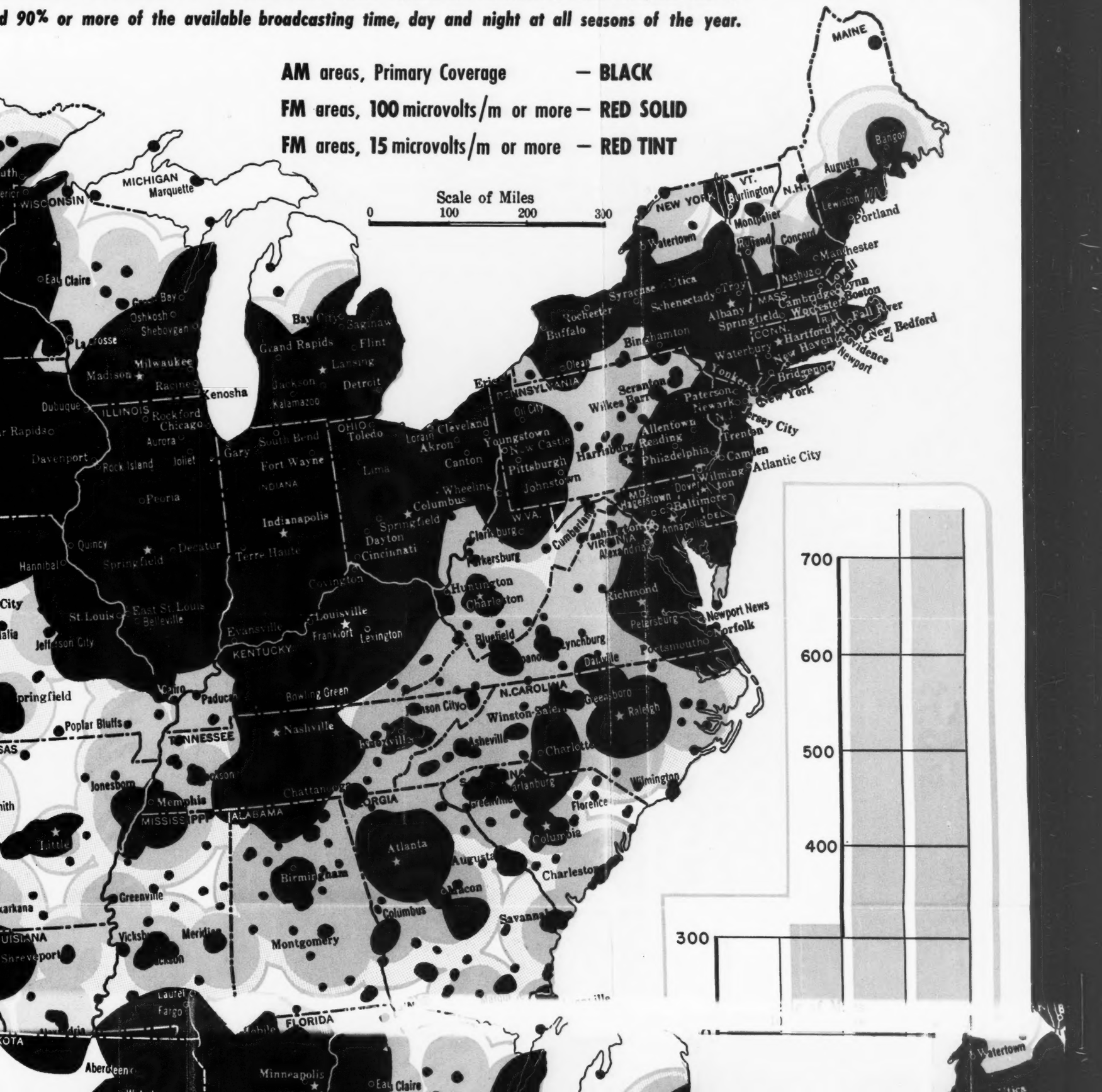
DIO RECEPTION -- FM vs AM

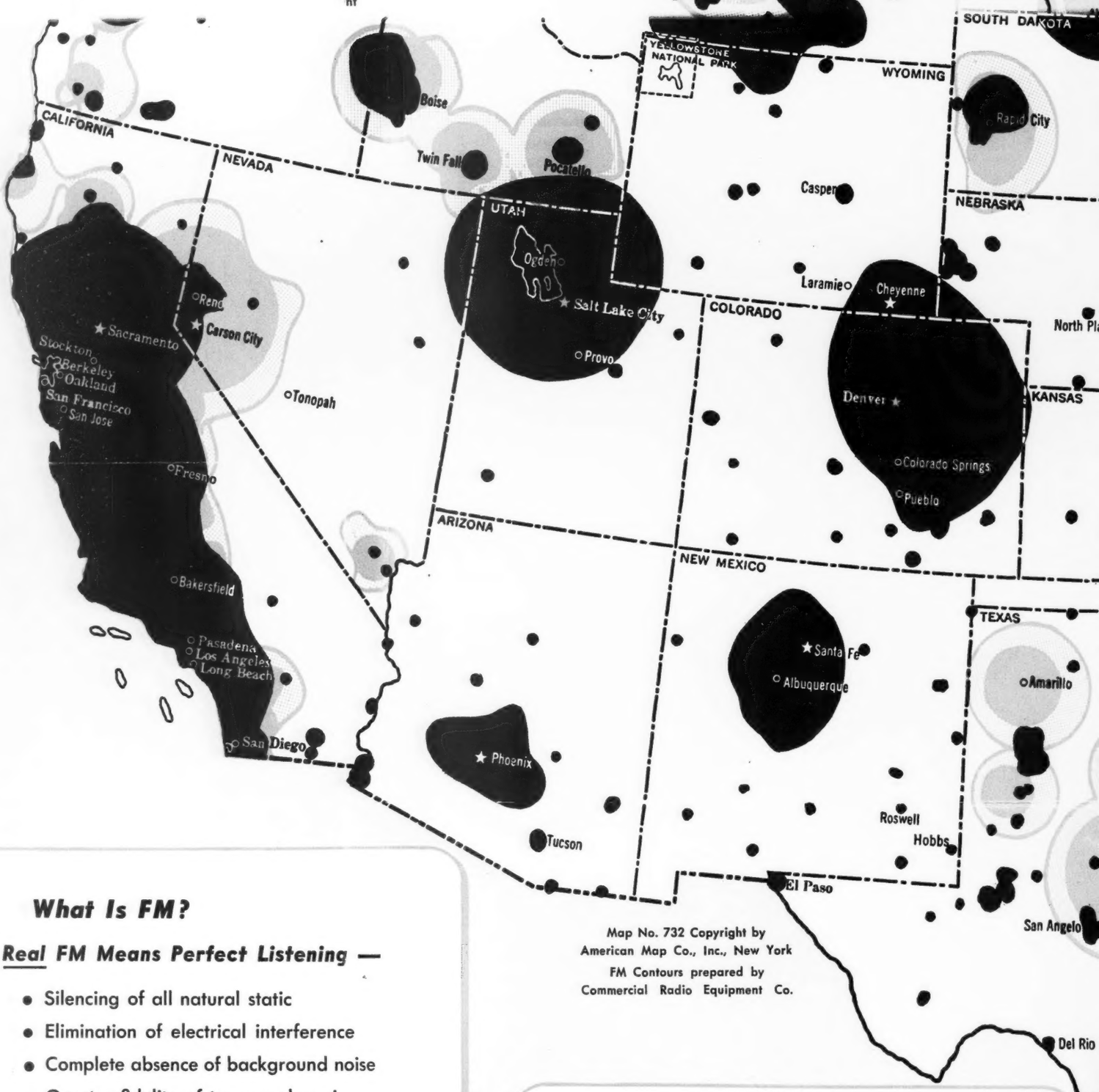
art shows those areas of the United States where dependable satisfactory radio reception can be d 90% or more of the available broadcasting time, day and night at all seasons of the year.

AM areas, Primary Coverage — **BLACK**

FM areas, **100** microvolts/m or more — **RED SOLID**

FM areas, **15** microvolts/m or more — **RED TINT**





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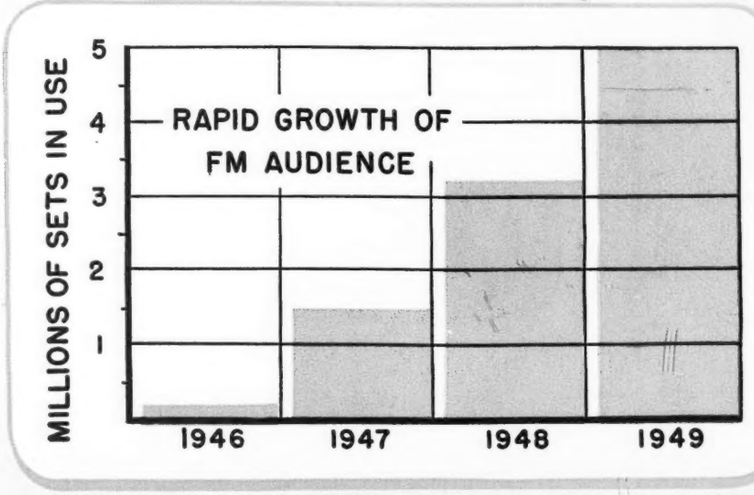
FM Contours prepared by
Commercial Radio Equipment Co.

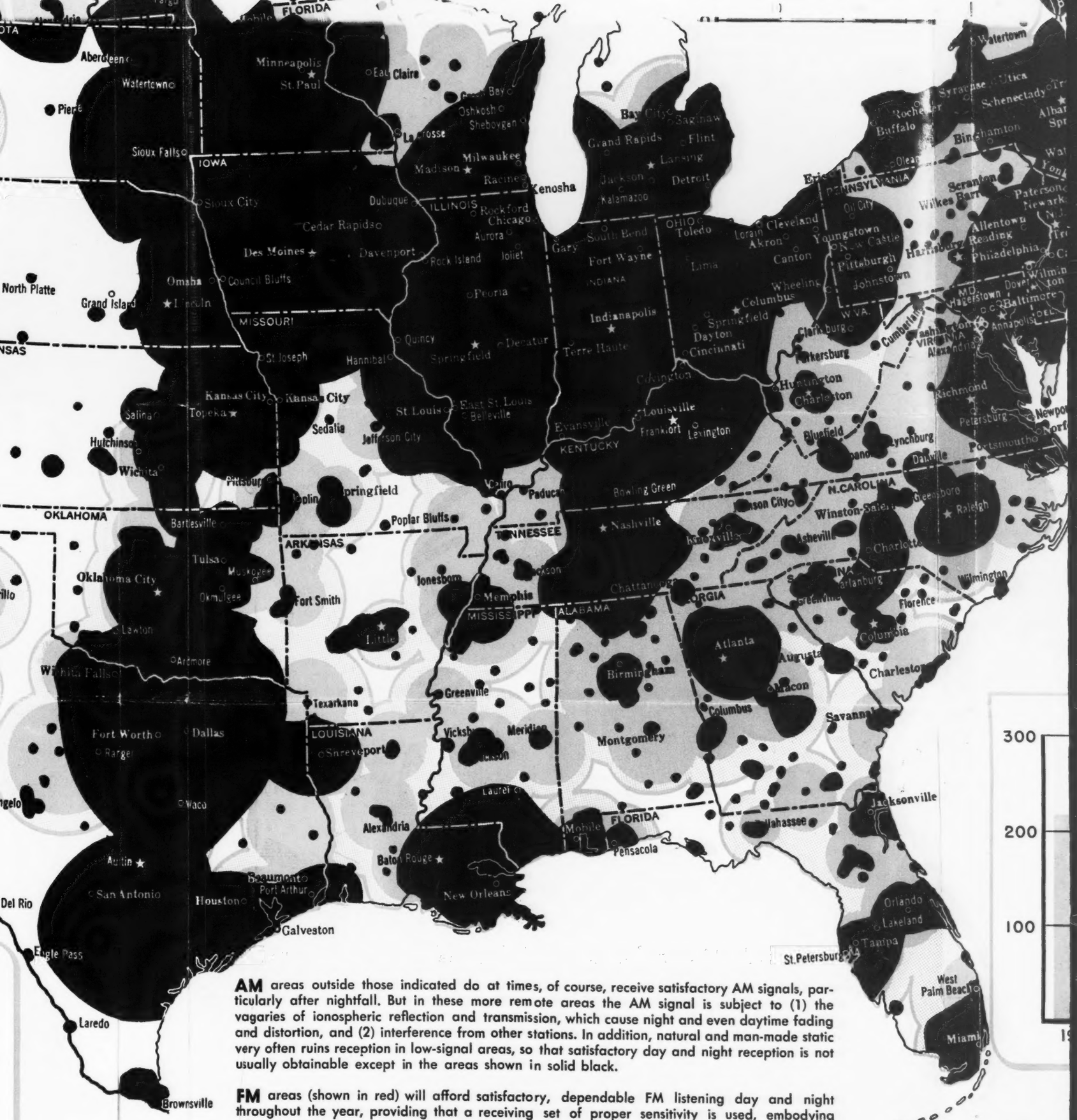
What Is FM?

Real FM Means Perfect Listening —

- Silencing of all natural static
- Elimination of electrical interference
- Complete absence of background noise
- Greater fidelity of tones and music
- Uniform reception day and night
- Absence of fading and distortion
- Ability to get clear distinct reception by "reaching up" with adequate antenna



TELE-TECH
TELEVISION • TELECOMMUNICATIONS • RADIO
AUGUST • 1949



AM areas outside those indicated do at times, of course, receive satisfactory AM signals, particularly after nightfall. But in these more remote areas the AM signal is subject to (1) the vagaries of ionospheric reflection and transmission, which cause night and even daytime fading and distortion, and (2) interference from other stations. In addition, natural and man-made static very often ruins reception in low-signal areas, so that satisfactory day and night reception is not usually obtainable except in the areas shown in solid black.

FM areas (shown in red) will afford satisfactory, dependable FM listening day and night throughout the year, providing that a receiving set of proper sensitivity is used, embodying adequate noise-suppression circuits (notably those of Dr. E. H. Armstrong) and providing that an antenna of proper height is installed. In the red-tinted areas shown, the owner of a good FM set can always "reach up" to get high-quality, undistorted reception free of interference. In contrast, existing local AM signals may be of much greater field strength but so mutilated by natural and artificial static or by other AM stations on the same channel, that (with any height of antenna) intelligible or enjoyable reception is impossible.

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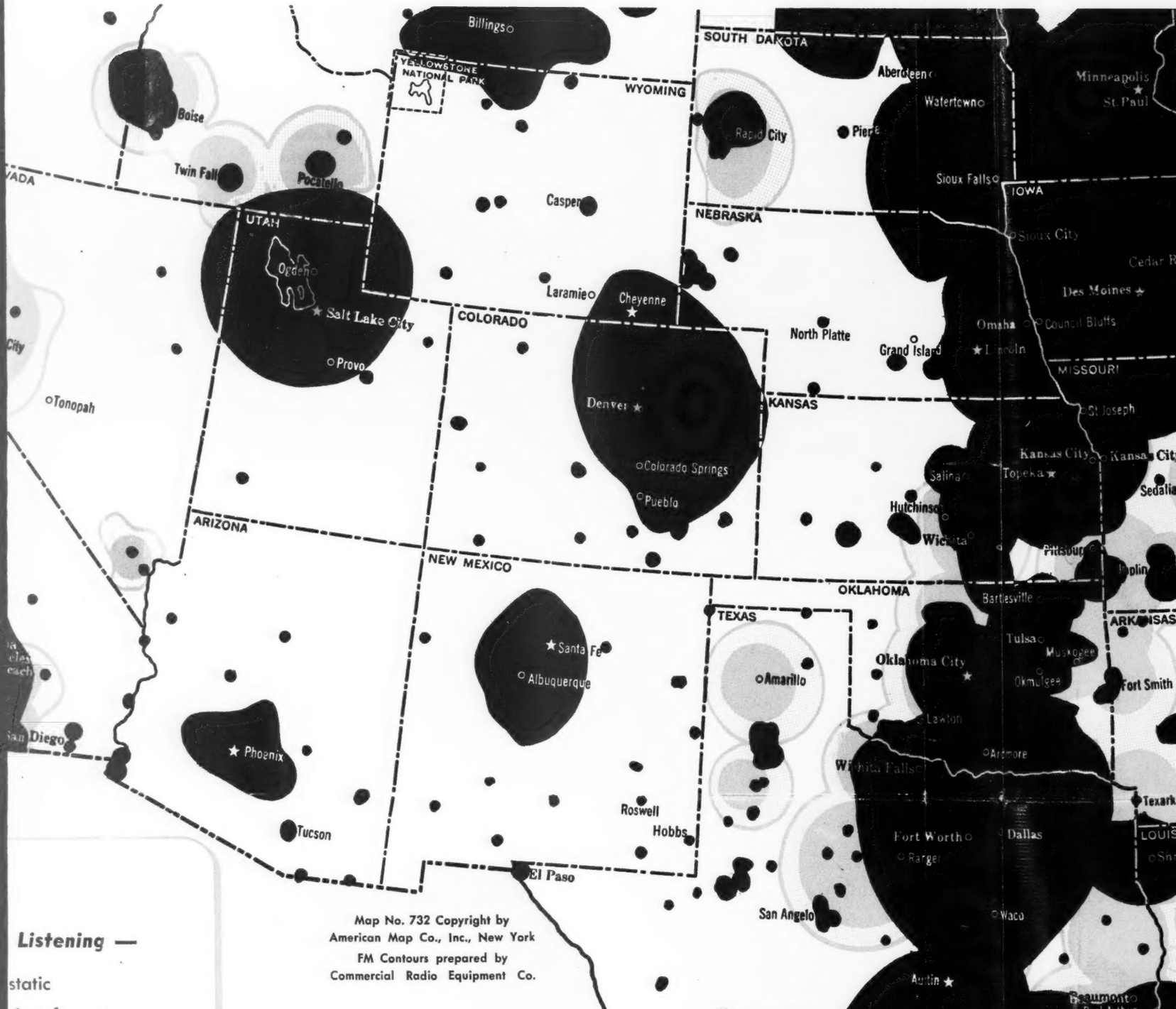

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Listening —

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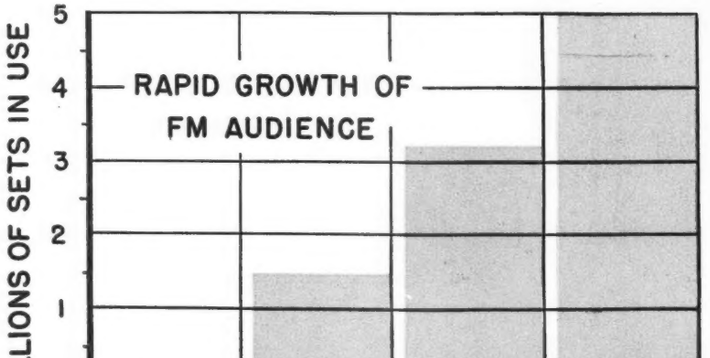
adequate antenna



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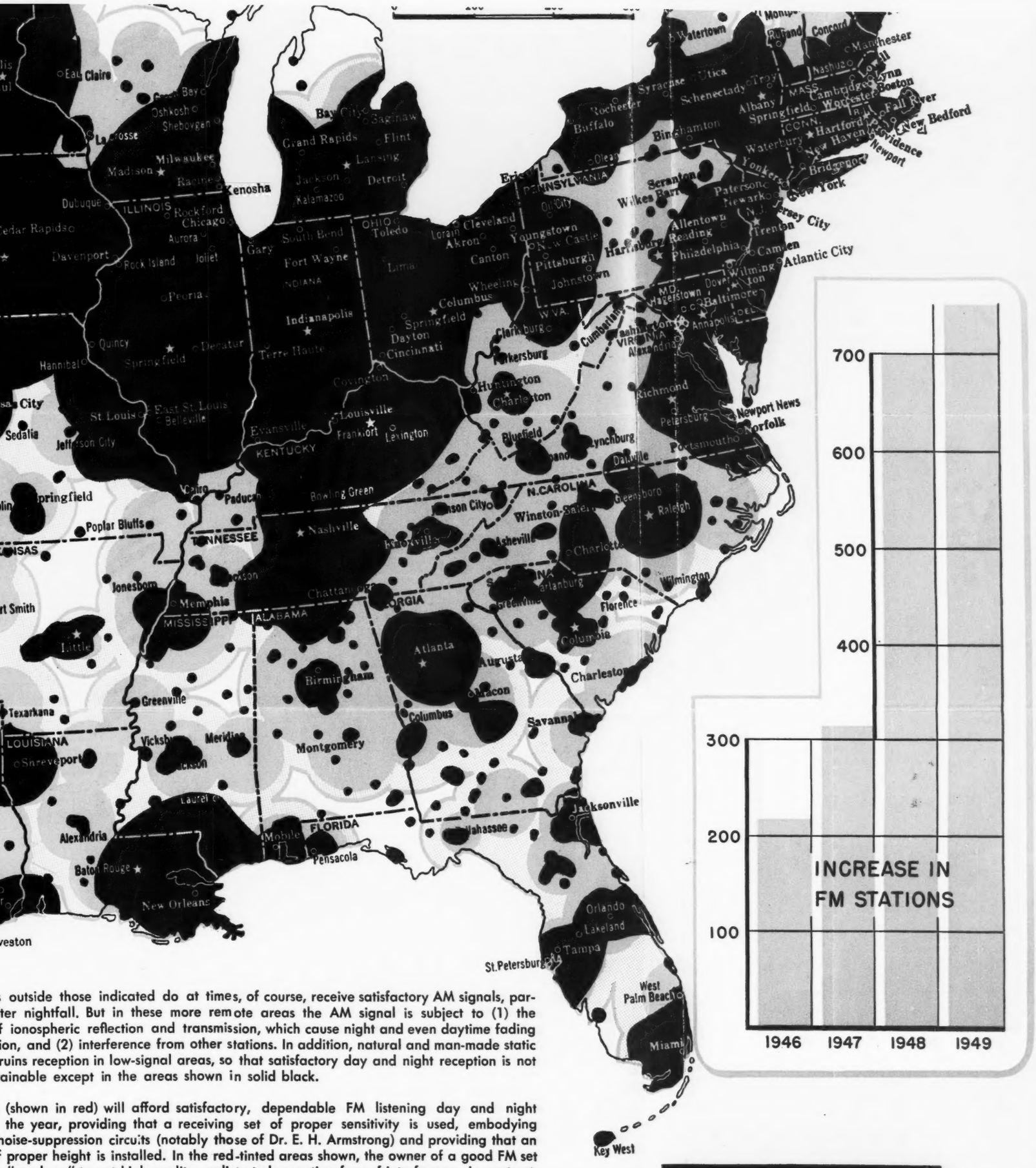

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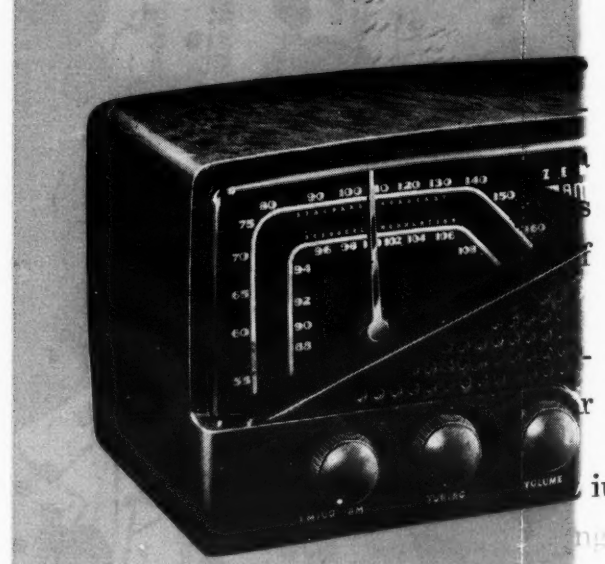
The coverage map shows it . . . every day thousands more radio listeners know it . . . you've got to have a radio with top FM reception as well as AM to *really* enjoy America's new era of radio broadcasting!

These terrific Zenith FM-AM performers are the answer. They give your customers the best long-range reception in *both* FM and AM—at the right price—in the smartest, sturdiest cabinets Zenith has *ever* designed for table radios.

Yes, here is the big new sales opportunity you have been looking for. When you sell Zenith, you just don't have any competition to concern you!



The map doesn't show . . . that in many areas which do have FM reception, some ordinary FM receivers will bring in only one or two stations, yet Zenith *Super-Sensitive* sets will provide FM reception from five, ten and even more stations.

ORDER THESE SETS FROM YOUR ZENITH DISTRIBUTOR

New Zenith "SUPER-SYMPHONY"

Extra-large, extra-powerful speaker, thanks to Zenith's exclusive DialSpeaker design. Surpasses many consoles in tone and performance. Improved tone control. New *super-sensitive* Zenith-Armstrong FM with patented Power-Line Antenna, plus Long Distance Zenith AM. Improved Zenith Wavemagnet. Smart swirl walnut plastic cabinet. AC, DC.

$79.95* WHITE PLASTIC **$82.50***

New Zenith "SUPER-TRIUMPH"

A terrific value! New *super-sensitive* Zenith-Armstrong FM with patented powerline Antenna, and famous Zenith Long Distance AM. Exclusive Wavemagnet... big Alnico 5 Speaker... tone control ... on/off indicator ... easier-to-tune "Cut-Away" Dial. Beautiful swirl walnut plastic cabinet with "Flexo-Grip" handle. AC, DC.

$59.95* WHITE PLASTIC **$62.95***

*Suggested Retail Price—West Coast prices slightly higher.

Prices subject to change without notice.

Put New Life Into Your R

with these New Zenith FM-AM

The coverage map shows it . . .

customers the best long-range reception

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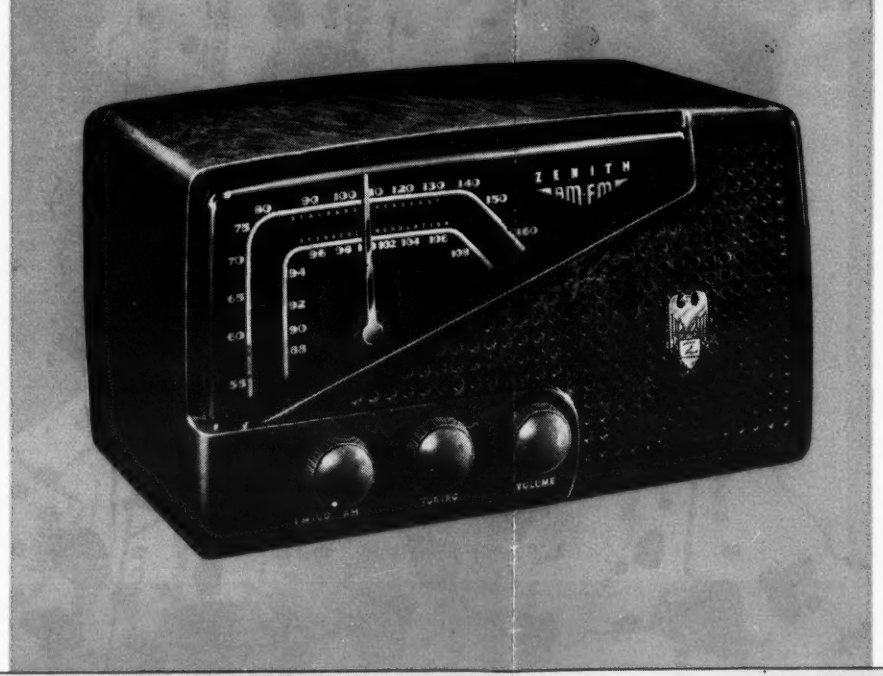

New Zenith "MEDALLION"

Big value at low cost! Genuine Zenith-Armstrong FM with exclusive Power-Line Antenna, just plug in and play . . . sensational Zenith Long Distance AM . . . new "Cut-Away" Dial for easier tuning . . . Zenith Wavemagnet . . . Alnico 5 Speaker. Handsome swirl walnut plastic cabinet. AC, DC.

$49.95*

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New Zenith "SUPER-SYMPHONY"

Extra-large, extra-powerful speaker, thanks to Zenith's exclusive DialSpeaker design. Surpasses many consoles in tone and performance. Improved tone control. New *super-sensitive* Zenith-Armstrong FM with patented Power-Line Antenna, plus Long Distance Zenith AM. Improved Zenith Wavemagnet. Smart swirl walnut plastic cabinet. AC, DC.

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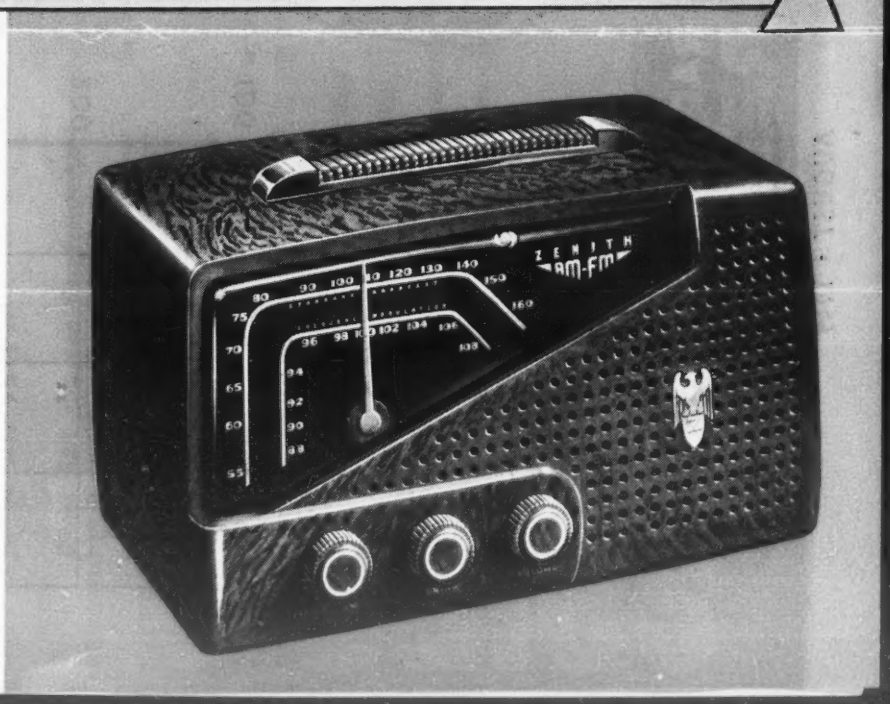

fe Into Your Radio Sales

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